REVIEW OF SUBMISSIONS ON THE COST OF DEBT AND THE TAMRP FOR UCLL AND UBA SERVICES

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CONTENTS

EXECUTIVE SUMMARY

This paper has reviewed recent submissions to the Commerce Commission on its methodology for the cost of debt and the TAMRP, and has also offered estimates of the TAMRP over both five and ten year periods. The conclusions are as follows.

Firstly, I do not support CEG's recommendation to include foreign currency denominated bonds in the DRP estimation process due to concerns about the liquidity of such bonds, other data quality issues, and the need to then determine the appropriate weights to place on different types of bonds. Lest this raise concerns about bias in estimating a firm's average DRP (over all sources), I understand that the DRPs on local currency bonds are not systematically above those on foreign-currency denominated bonds. Consequently, the use of only local-currency bonds in estimating a firm's DRP may sometimes be too high and sometimes too low but the average error will tend to zero over time.

Secondly, in choosing a target credit rating for New Zealand suppliers of UCLL/UBA services, placing sole or primary weight on Chorus's credit rating as favoured by CEG will discourage Chorus from actions that raise it credit rating and weaken its incentives to maintain its rating. Accordingly, in choosing a target credit rating for New Zealand suppliers of UCLL/UBA services, I do not favour the Commission placing sole or primary weight on Chorus's credit rating.

Thirdly, both averaging over yields on bonds with the relevant term to maturity and curve fitting are viable approaches to estimating the DRP. Since one approach is not manifestly superior (unless there are many bonds with the relevant term to maturity) and there is no necessity to favour one approach over the other, I recommend that results from both approaches be considered. In the same way, a better estimate of the MRP arises by considering estimates from a range of methodologies.

Fourthly, I do not support firm-specific use of the TCSD because it encourages firms to lengthen their average debt term without consideration of the cost of doing so.

Fifthly, even if firms borrow for a term that equals the regulatory cycle, an allowance for the transactions costs on interest rate swap contracts is warranted because firms (sensibly) stagger their borrowing arrangements. Currently, such firms do not receive that allowance.

Sixthly, the available evidence suggests that regulated firms in New Zealand have an average debt term of about seven years rather than the ten years claimed by CEG.

Seventhly, CEG's criteria for selecting the appropriate regulatory debt policy are too narrow and recourse to a more comprehensive set of tests leads to the conclusion that the best policy is to invoke the risk free rate at the beginning of the regulatory cycle (with a term matching the regulatory cycle) coupled with a DRP set at the beginning of the regulatory cycle (with a term matching the average term for which firms borrow), plus the transactions costs of interest rate swap contracts to align the risk-free rate component of the firm's staggered debt with the regulatory cycle. This is similar to the current regime (but with allowance for the transactions cost of interest rate swaps and without the TCSD).

Eighthly, I do not support CEG's proposal to estimate the TAMRP over the next five years using only a version of the DGM primarily because such an approach produces implausibly high variation over time in the estimated TAMRP and because reliance on only one method rather than an average over several methods is likely to be less reliable. In addition, although CEG cite an empirical paper in support of their use of the DGM, the version used by CEG differs from that used in the cited paper, the cited paper does not use New Zealand data, and the empirical tests carried out in the cited paper may provide evidence of market inefficiency rather than evidence in support of the DGM as a good predictor of the market risk premium.

Finally, I have estimated the TAMRP using five methods, comprising historical averaging of excess returns, correcting these returns for the 20th century inflation shock, historical averaging of real market returns coupled with the current risk free rate and expected inflation, the DGM favoured by CEG, and surveys. All five methods have been applied to both New Zealand and foreign data, and estimates are provided for both five and ten-year terms. In respect of New Zealand data and a five-year term, the estimates range from 5.9% to 8.2% with a median of 6.9%. Using foreign data and a five-year term, the estimates range from 6.3% to 9.7% with a median of 7.3%. So, even if rounded to the nearest 0.5%, an appropriate estimate is 7%, which matches that currently used by the Commission. In respect of a ten-year term, the estimates range from 5.7% to 7.9% with a median of 6.7% when using New Zealand data, and from 6.1% to 9.2% with a median of 7.3% when using foreign data. So, again, an appropriate estimate is still 7%. In all cases, whether using foreign or New Zealand data and whether estimating the TAMRP over a five or ten year term, the DGM favoured by CEG always produces the highest results and is therefore the outlier.

1. Introduction

The Commerce Commission (2014) has recently sought submissions on the cost of capital for UCLL and UBA services. This paper reviews submissions received on the cost of debt from CEG (2014), Network Strategies (2014), and PwC (2014), and on the TAMRP from CEG (2014). I then proceed to estimate the TAMRP, for both five and ten-year terms.

2. CEG on the Cost of Debt

2.1 The Use of Foreign Currency Bonds

CEG (2014, section 4.1) argues that foreign-currency denominated bonds should be included in the set of bonds used to estimate the DRP, on the grounds that they are prevalent and will therefore expand the set of bonds used. CEG also cites work by Arsov et al (2013) in support of this approach.

The inclusion of foreign currency denominated bonds in a DRP estimate is problematic on a number of grounds. Firstly, these bonds are not very liquid because the holders of them typically hold till maturity (QTC, 2012, Attachment 1, page 25). Consequently, secondary market based estimates (from parties such as Bloomberg) would have low quality. Alternatively, if primary market data were used, this would be unsatisfactory because the set of comparator debt issuers will be small and it would be unusual for any of them to have issued foreign denominated bonds within the DRP estimation window. Thus, primary market data would be rare and secondary market based estimates (from Bloomberg, etc) would have low quality.

Secondly, in respect of primary market data, I understand that the rate differential between local bonds and otherwise identical foreign denominated bonds fluctuates considerably over time, with the differential typically up to 1%.[1] Since the DRP comprises allowances for expected default losses, the illiquidity of the bonds relative to government bonds, and

[1] Foreign currency denominated borrowing is more prevalent when it is cheaper but other considerations are involved, including the desire by firms to diversify their sources of finance and the inability to obtain very long-term borrowing locally. Thus, even if foreign currency denominated borrowing were more expensive, some level of it would still be observed.

systematic risk[2], the DRPs paid by a given New Zealand borrower may differ between local and foreign borrowing because local and foreign lender perceptions of the default risk of New Zealand firms may be different, premiums for the relative illiquidity of the bonds may differ across markets, and the premiums for systematic risk are likely to be different (as noted by Davis, 2011, pp. 7-9).[3] This raises the question of why such foreign denominated bond data might be used by a regulator. If it were being used merely to assist in estimating the DRP of a local currency bond, it may therefore provide a poor estimate. Alternatively, if it were being used to better reflect the average cost of a firm's debt finance, then this would raise contentious questions about whether to also include the cost of bank debt (the third primary source of debt finance), estimating the weights to be placed upon such sources of debt, and the issue of whether to apply the same weights to firms who may not have access to foreign borrowing (due to their limited size and/or the lack of a credit rating).[4] In respect of estimating the appropriate weights, the optimal weights for local and foreign borrowing will fluctuate through time (inversely with relative costs), and therefore the current (observed) weights may be a poor proxy for the optimal weights because those observed weights will reflect the relative attractiveness of the different types of debt at various points in the past.

Thirdly, in respect of secondary market data, the buyers of such bonds come from a variety of markets.[5] If they are from the same market as the lender, the DRP estimated from secondary

[2] Elton et al (2001) conclude that most of the DRP is compensation for systematic risk whilst Dick-Nielsen et al (2012, Table 5) conclude that about 25% of the DRP on A to BBB bonds was due to illiquidity in the period 2007-2009.

[3] In respect of systematic risk, financial institutions in (say) the US who lend to New Zealand rather than US companies are akin to US investors who buy New Zealand rather than US equities. In both cases, with imperfect integration of markets, the imperfect correlation between the New Zealand and US markets implies that the New Zealand investments exert a lower impact than further US investments upon the risk of the portfolio of assets currently held by these US investors. Furthermore, in respect of lending, one would expect the benefits to be shared with the borrowers in the form of a lower DRP than they would pay on local borrowing so as to encourage borrowers to seek foreign loans. These effects may or may not persist after the issue date because the interest rate data is then from the secondary market and secondary market buyers may or may not be from the same market.

[4] Firms without a credit rating would be excluded from most foreign bond markets. In addition, due to the fixed costs of foreign borrowing and minimum bond issue sizes imposed by the market itself, smaller businesses would also be excluded. For example, I understand that the minimum transaction size in the US public debt market is about US$500m. Thus, a firm with an average debt term of five years, and therefore an average rollover proportion of 20% per year, would have to have total debt of about US$2500m in order to enter the US public debt market. With leverage of 40%, this implies assets of about $6000m. Even in the US private placement market, I understand that the minimum transaction size is US$100m, and therefore is limited to regulated firms with assets of at least US$1200m.

[5] This is apparent from examining the ownership composition of some of these foreign currency denominated bonds, as provided by Bloomberg.

market data would tend to be similar to that based upon primary market data (absent any new information). However, if buyers are from another market, the DRP estimated from secondary market data could be quite different and this will aggravate the problems outlined in the previous paragraph. In particular, if the data is being used merely to assist in estimating the DRP of a local currency bond, it may therefore provide a poor estimate. Alternatively, if it were being used to better reflect the actual costs of a firm's debt finance (in the primary market), then it may provide a very poor estimate in addition to raising contentious questions about whether to also include bank debt, the weights to be placed upon such sources of debt and the application of those weights to firms who do not have access to foreign borrowing.

To illustrate this point, suppose Company X borrows in $US at 7.5% (after swapping into NZD), could borrow locally at 7.0%, and secondary market transactions on the foreign borrowing shortly after issue of the bonds were at 7.5%. In this case the primary market data would overestimate the cost of local borrowing but accurately estimate the cost of foreign borrowing, whilst the secondary market data would do likewise. By contrast, if the secondary market transactions were at 7.0%, then this data would correctly estimate the cost of local borrowing but underestimate the cost of foreign borrowing.

In respect of secondary market transactions and DRP estimates based upon this, Bloomberg data presented by CEG (2012a) reveals a significant difference between the costs of Australian and foreign borrowing by Australian firms. CEG's Figure 7 shows the Bloomberg Fair Value Curve (BFVC) for BBB bonds and the yields (after the currency swaps) from 19 foreign currency denominated BBB bonds. The vast majority of these bond yields are above the curve and the average margin above it is 1.55%.[6] By contrast, CEG's Figure 3 shows the DRPs on local currency BBB bonds and the BFVC for BBB bonds, with data drawn from the same period as with Figure 7 (and similarly excluding callables other than make-whole callables). In this case the average DRP on the BBB bonds relative to the BFVC is very close to zero (-0.04%). It follows that the average DRPs on the foreign currency denominated bonds exceed those on local currency bonds by about 1.6%. In addition CEG show Bloomberg and UBS data on AUD denominated bonds (Figure 12) and both AUD and

[6] Remarkably, in spite of this, CEG (2012a, page 26) claims that the BFVC fits the data well. Presumably the data referred to by CEG is all data on Figure 7 but the average credit rating of this data is above BBB and therefore not comparable with the BBB curve.

foreign-currency denominated bonds in Figure 13, and then fits Nelson-Siegel curves to this data for BBB, BBB+ and A- bonds. In respect of Figure 12, the simple average of the three curves at the ten-year maturity is 7.38% and the corresponding result for Figure 13 is 7.93%. Furthermore, in moving from Figure 12 to Figure 13, the data set increases from 110 bonds to 297 bonds (CEG, ibid, pp. 36-37). It follows that 187 of the total set of bonds are foreign currency denominated and they represent 63% of the total. The average ten-year yield on the foreign currency denominated bonds must then be x satisfying the following equation:

$$x(0.63) + 7.38\%(0.37) = 7.93\%$$

It follows that $x = 8.25\%$. Thus the average yield on the ten-year foreign currency denominated bonds is 0.87% larger than on AUD bonds (8.25% v 7.38%). Both this difference and the 1.6% referred to above are substantial. If the cause of the difference lies only in data quality, such as estimates that have not been updated by Bloomberg or UBS, then this reinforces the need to select only high quality data. Alternatively, if the difference is genuine and the foreign currency denominated bonds are included, then (as noted above) it raises potentially contentious questions about whether to also include the cost of bank debt, the weights to be placed upon such data, and the issue of whether to apply the same weights to firms who may not have access to foreign borrowing.

In summary, I do not support CEG's recommendation to include foreign currency denominated bonds in the DRP estimation process due to concerns about liquidity, data quality, and the appropriate weights to place on different bond types. Lest this raise concerns about bias in estimating a firm's average DRP (over all sources), I understand that the DRPs on local currency bonds are not systematically above those on foreign-currency denominated bonds. Consequently, the use of only local-currency bonds in estimating a firm's DRP may sometimes be too high and sometimes too low but the average error will tend to zero over time.

2.2 The Target Credit Rating

CEG (2014, section 4.2) argues that the target credit rating for a UCLL/UBA provider should be that of Chorus (BBB by S&P or BBB- by Moody's) because it is the only New Zealand provider of such services. Such an approach would constitute a cost-based rather than an incentive-based approach to the cost of debt for a UCLL/UBA provider. Thus, if actions taken by Chorus raised its credit rating, this would lower its regulatory cost of debt and therefore weaken the incentive for Chorus to do so. Similarly, if actions taken by Chorus (or not taken when they should have been) lowered its credit rating, this would raise its regulatory cost of debt and therefore weaken the incentive for Chorus to maintain its credit rating. Such an approach would also expose the Commission to credit rating 'error' for a single firm by a credit rating agency or simply a lag in the agency's resetting of the credit rating to reflect new information.

In summary, in choosing a target credit rating for New Zealand suppliers of UCLL/UBA services, placing sole or primary weight on Chorus's credit rating as favoured by CEG will discourage Chorus from actions that raise it credit rating and weaken its incentives to maintain its rating. Accordingly, in choosing a target credit rating for New Zealand suppliers of UCLL/UBA services, I do not favour the Commission placing sole or primary weight on Chorus's credit rating.

2.3 Estimating the DRP

CEG (2014, sections 4.3-4.5) goes on to estimate the DRP for Chorus. To increase the number of observations, CEG draws upon bonds with credit ratings that are within two notches of Chorus's alleged credit rating of BBB- (BB to BBB+), as shown in their Figure 1. CEG considers two possible methods of curve fitting followed by assigning increasingly higher weight to the Chorus bond (as shown in their Table 8). The results range from 2.19% (RBA curve fitting at 5 years) to 4.35% (the Chorus bond yield). CEG do not propose a DRP but instead seek to identify a number of possible approaches.

I have the following comments about this. Firstly, CEG use a target credit rating of BBB-, on the grounds that this is Chorus's rating. However, as they note in their para 127, S&P rate Chorus at BBB and Moody's rate them at BBB-. So, if one were going to set the target credit rating using such information, it ought to be BBB-/BBB, and therefore bonds within two credit notches would be BB+ to BBB+ rather than BB to BBB+. Secondly, the exercise is premised on setting the target credit rating in accordance with Chorus's credit rating and, as discussed in the previous section, this approach has very significant drawbacks.

Thirdly, CEG uses curve fitting techniques to estimate the DRP at a specified term to maturity. The alternative is to collect a set of DRP estimates on suitable bonds with residual terms to maturity of the desired term, followed by averaging over these estimates. The extent of data that is available will be a factor in this choice. For example, if there were minimal observations around the required term, then curve fitting would be required. Otherwise the choice exists. Averaging suffers from the problem of ignoring useful information outside the averaging band. CEG (2012a, pp. 50-52) has also argued that it suffers from the fact that the yield curve is concave and therefore averaging over the yields of a set of bonds with an average term to maturity of (say) ten years will induce downward bias in the DRP estimate for a ten year bond. However, it is also true that firms issue bonds with a wide range in their lives[7] and the appropriate DRP would average over them but general practice is instead to estimate the DRP at the average term; this bias is upward rather than downward and is likely to be more significant than the downward bias identified by CEG.

To illustrate this point, suppose that firms issue bonds with maturities of 2, 5, and 10 years, with DRPs of 2%, 2.5% and 2.75%. Suppose also that a regulator seeks only to estimate the DRP of five-year bonds and uses data on three bonds, with terms to maturity of 4, 5, and 6 years and DRPs of 2.3%, 2.5%, and 2.65%. The resulting DRP estimate would average over the last three numbers, yielding 2.48% rather than the 2.5% for five-year bonds and the shortfall of 0.02% is CEG's downward bias. However, had the regulator averaged over the DRPs of 2, 5 and 10 year bonds, so as to properly reflect the spread in a single firm's bond lives, the result would have been 2.42%. Thus the net effect of these two biases is upward, by 0.06%. So, if regulators do define the DRP of the benchmark firm to be that associated with a single term (such as five years), it would be desirable for them in estimating this DRP to average over the DRPs of various bonds with a range of terms to maturity around the five-year average, so as to reverse out the upward bias arising from their definition of the DRP of the benchmark firm.

In respect of curve fitting, this suffers from the need to choose amongst competing curve-fitting functions. CEG (2014, section 4.4) presents results from applying the Gaussian kernel approach adopted by Arsov et al (2013) and the Nelson-Siegel model. Alternative models are

[7] I understand that the principal sources of debt for New Zealand corporates are bank loans, New Zealand public debt issues, and foreign bonds (public debt issues or private placements). I also understand that the term for bank loans typically does not exceed five years whilst the term for foreign bonds is typically at least ten years.

those of Svensson (1994), which adds extra parameters to the Nelson-Siegel model to allow for the possibility of a second 'hump', and 'spline' approaches in which the yield curve is a series of segments rather than a single function. Amongst the world's central banks, each of these approaches have their supporters and this implies that there is no professional consensus on the best approach (BIS, 2005, Table 1). Curve fitting also suffers from the need to obtain high quality DRP data over a wider range of maturities. Given the need for a wider range of maturities, the temptation to loosen standards (by admitting lower quality data) will be strong and the result of this is likely to be a biased estimate of the DRP of concern.

In summary, both averaging over yields on bonds with the relevant term to maturity and curve fitting are viable approaches to estimating the DRP. Since one approach is not manifestly superior (unless there are many bonds with the relevant term to maturity) and there is no necessity to favour one approach over the other, I recommend that results from both approaches be considered. In the same way, a better estimate of the MRP arises by considering estimates from a range of methodologies.

2.4 Debt Management Strategies

CEG (2014, section 5) argues that the appropriate regulatory approach to setting the allowed cost of debt must be consistent with the way in which regulated firms behave, capable of being replicated by firms, involve low transactions costs for firms in the course of replicating, and yield low price volatility to consumers.[8] In respect of observed behaviour, CEG claims that regulated firms use a long average debt term (about 10 years) coupled with staggering of debt so that only a small proportion of debt requires refinancing in any one year. In respect of replication, CEG consider that it is important for a benchmark regulated firm to be able to replicate a strategy used by a regulator so as to minimise their risk and therefore maximise their incentive to invest.

CEG argues that there are only two regulatory approaches to setting the allowed cost of debt that warrant consideration. The first (Option 1) involves the prevailing swap rate at the beginning of the regulatory cycle (with a term matching the regulatory cycle) coupled with a DRP (defined relative to the swap rate) equal to its historical average (over a period matching the average term for which regulated firms borrow, which is about 10 years). The second

[8] CEG (ibid, para 229) also refer to minimal divergence between the cost of debt incurred by the firm and that allowed by the regulator. This seems to be covered by the ability of firms to replicate the regulator's strategy.

(Option 2) is equal to the historical average cost of debt, over a period matching the average term for which firms borrow (which is about 10 years). CEG argues that the first option is inferior because it incurs the transactions costs associated with the interest rate swap contracts (which are aggravated for firms seeking very large swap contracts within the relevant period) and it would significantly raise the volatility in prices faced by customers.

CEG also critiques the Commission's existing practice, under which firms whose average debt term does not exceed five years are subject to the cost of five year debt prevailing at the commencement of the regulatory cycle (Option 3) whilst firms with an average debt term in excess of five years have their cost of debt augmented by the 'TCSD'(an increment to the Option 3 DRP for each bond issue with a term beyond five years, in accordance with its additional term, plus the transactions cost of an interest rate swap contract to convert the risk free rate component of this bond to the five-year rate, less the reduction in the per annum debt issue costs resulting from this bond having a term exceeding five years). In respect of Option 3, CEG argues that this approach grants an allowance to firms that does not match the cost incurred by the firm because firms stagger their debt and are unable to convert the DRP incurred through this staggering process to the DRP prevailing at the beginning of the regulatory cycle.

My views on this matter are as follows. Firstly, I do not support a TCSD because it is a cost-based scheme rather than an incentive-based scheme. Incentive-based schemes grant the same allowance to all firms, and firms are free to behave differently if they wish (receiving the benefits or bearing the cost from doing so). Thus, if all firms receive a DRP allowance based upon five-year debt, some firms may prefer longer term debt because they consider that the reduction in refinancing risk more than compensates for the higher DRP whilst others may prefer shorter term debt because they consider that the reduction in refinancing risk does not compensate for the higher DRP. By contrast, the TCSD applies different rules in accordance with the firm's actual behaviour. In particular, if a firm chooses longer-term debt, it will receive a higher DRP allowance. Under such conditions, all firms could be expected to prefer longer-term debt because they would thereby reduce their refinancing risk and would not bear the increased DRP. The Commission may feel that it is desirable for firms to adopt longer-term debt. If so, it should grant a DRP allowance for debt of a longer term than five years, and grant it uniformly to all firms.

Secondly, in respect of Option 3, this does not involve an allowance for the transactions costs of interest rate swap contracts and such an allowance should be granted to compensate firms for the costs of aligning the risk free rate component of (staggered) five-year debt to the regulatory cycle even if the firm's debt term is five years. For example, if the regulatory cycle is 2010-2015 and the firm has five-year staggered debt, only 20% of the debt will commence in 2010 (due to the staggering) and the other 80% will require interest rate swap contracts to align its risk-free rate component with the cycle.

Thirdly, in respect of CEG's proposed use of the swap rate, this is conceptually desirable because interest rate swap contracts are based on this rate and firms would therefore be better able to hedge their interest rate risk. However, such swap contracts would not be required if CEG's proposed approach to the cost of debt were adopted, and this would undercut the merits of the Commission using the swap rate. Even if CEG's proposed approach to the cost of debt were not adopted, the hedging gains are not very large (see Lally, 2014a, section 3). So, the argument for change is not strong.

Fourthly, CEG's belief that the average debt term for regulated firms is ten years (CEG, 2014, pp. 48-50) seems to conflict with the evidence presented by the Commerce Commission (2010, pp. 449-451). However most of the apparent conflict in evidence arises because CEG presents data from a range of markets whilst the Commission favours New Zealand data. New Zealand data is preferable, because it is more relevant. However it does suggest a figure of about seven years rather than five years.

Fifthly, CEG's criteria for selecting the best regulatory approach to setting the allowed cost of debt should be augmented. My recommended 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 not give rise to undesirable incentives, most particularly in respect of capex and new entrants to the regulated sector.
(3) It should be possible, and simple, to implement it.
(4) It should minimise bankruptcy risk for the firm.
(5) It should give rise to a low average output price to consumers.

(6) It should give rise to low volatility in the output price to consumers.

(7) If a change in regime occurs, any transitional process used should be simple and minimise the one-off gains or losses experienced by firms as a result of the regime change.

Compared to CEG's criteria, there is agreement on (6). In addition, CEG's criterion of low transactions costs is subsumed within criteria (5) above, i.e., low transactions costs are not important per se but only as a contributor to low prices to consumers. In addition, CEG's criteria relating to being consistent with the way in which firms behave and the ability of firms to replicate the regulatory approach is subsumed within (1) above. Thus, I agree with the individual criteria proposed by CEG but add several more considerations.

Finally, I rate three competing regulatory options against these criteria. The competing options are very similar to those described earlier:

Option A: The risk free rate at the beginning of the regulatory cycle (with a term matching the regulatory cycle) coupled with the DRP at the beginning of the regulatory cycle (with a term matching the average term for which firms borrow), plus the transactions costs of interest rate swap contracts to align the risk-free rate component of the firm's staggered debt with the regulatory cycle. This is similar to the current regime (but without the TCSD and with allowance for the transactions cost of the interest rate swaps).

Option B: The risk free rate at the beginning of the regulatory cycle (with a term matching the regulatory cycle) plus the historical average DRP (over a period matching the average term for which regulated firms borrow), plus the transactions costs of interest rate swap contracts to align the risk-free rate component of the firm's staggered debt with the regulatory cycle. The historical average DRP may be updated annually.

Option C: The historical average cost of debt, over a period matching the average term for which firms borrow. The historical average cost of debt may be updated annually.

In respect of criterion (1), there is no viable debt strategy that could be coupled with Option A to satisfy the NPV = 0 principle. All viable debt policies require staggering of the borrowing (to reduce refinancing risk to an acceptable level) and therefore the DRP incurred by a firm would be the trailing average rather than the DRP at the beginning of the regulatory cycle.[9] Since the regulator allows a DRP that reflects the rate prevailing at the beginning of each regulatory cycle, under Option A, and the firm pays the trailing average DRP, this combination of firm and regulatory policy will not satisfy the NPV = 0 principle. By contrast, Option B satisfies the NPV = 0 principle, in conjunction with a debt policy of staggered borrowing coupled with interest rate swap contracts to align the risk-free rate component of the firm's staggered debt with the regulatory cycle. Option C also satisfies the NPV = 0 principle, in conjunction with a debt policy of staggered borrowing but without interest rate swap contracts.

In respect of criterion (2), Option A satisfies this because it uses prevailing interest rates. By contrast, Option B does not satisfy it because it uses a historical average DRP. Thus, if the historical average DRP is below the current DRP, firms will be reluctant to engage in capex or to enter the regulated sector. Alternatively, if the historical average DRP is above the current DRP, capex and new entrants would be unjustifiably encouraged. These problems are even more severe for Option C because it uses the historical average risk-free rate as well as the historical average DRP. These problems could be addressed by applying the prevailing rate to new debt arising from both capex and new entrants, and then gradually adjusting the rate towards the trailing average. Furthermore, the QTC (2013b, section 2) demonstrates how this might be undertaken. However this adds to the complexity of the regime, and therefore to the ease with which it can be understood.

In respect of criterion (3), Option A is simple to implement. Option B is more complex to implement if the historical average DRP is updated annually or capex and new entrants are dealt with in the fashion described in the last paragraph. Option C has a further complication arising from the fact that firms often undertake interest rate swap contracts to shorten the effective term associated with the risk-free rate component of the cost of debt. Thus, if a firm borrows for ten years and swaps the risk free rate component into three year debt, the debt term would be ten years for the DRP but only three years for the risk free rate component. In respect of Option C, this would require different historical averages for the two components of the cost of debt. In respect of the swap contracts, these would have to be those of similar unregulated firms and these are simply unobservable. So, Option C is effectively incapable of being implemented. If it were implemented by ignoring the issue of these swap contracts,

[9] The CDS market does not yet seem to be sufficiently developed to enable firms to convert the DRP on borrowing arrangements that firms have undertaken into DRPs for different terms.

the result would typically be to overstate the cost of debt. For example, suppose that otherwise similar unregulated firms have ten-year debt, use interest rate swap contracts to convert the risk free rate component of their cost of debt to the three-year rate, the ten-year trailing average of the ten-year DRP is 2%, the ten-year trailing average of the ten-year risk-free rate is 6%, the three-year trailing average of the three-year risk-free rate is 5%, and the transactions costs of the swap contracts are 0.20%. The trailing average cost of debt of these firms is then 7.2%, comprising the three-year trailing average of the three-year risk-free rate of 5%, the ten-year trailing average of the ten-year DRP of 2%, and the transactions costs of the swap contracts. However, a regulator who merely observed their average debt term of ten years and ignored their interest-rate swap contracts would allow a ten-year trailing average of the ten-year cost of debt, with an average rate of 8%. The allowed cost of debt would then be too high by 0.8%.

In respect of criterion (4), additional bankruptcy risk arises under Option A because it determines the firm's revenues in accordance with the DRP prevailing at the beginning of the regulatory cycle whilst the firm actually pays a trailing average DRP, and this mis-match may raise the risk that the regulated entity would be unable to meet its debt obligations and therefore face bankruptcy risk.[10] However, in assessing bankruptcy risk, it is necessary to consider the other cash flows of the firm, most particularly the cash flows arising from the allowed cost of equity because they may mitigate the problem arising from the use of the prevailing DRP. Accordingly, the overall impact of changes in the DRP and the risk-free rate on bankruptcy risk, under Option A, is examined in Appendix 1. This reveals that the increased bankruptcy risk was trivial since 2007.

In respect of criterion (5), the average output prices under Option A and Option B are equal because they differ only in whether the prevailing or historical average DRP is used. Option C will yield higher average prices to the extent that the average debt term of firms exceeds

[10] The issue does not arise in respect of the risk free rate component of the cost of debt under Option A because the rate allowed is that prevailing at the beginning of the regulatory cycle and the same rate is effectively paid by businesses due to using interest rate swap contracts to align their borrowing terms to the regulatory cycle. The issue does not arise under Option B for the reason just noted in respect of the risk free rate and, in respect of the DRP, because the regulator uses a trailing average regime for the DRP and this will lead to a firm's incurred DRP closely corresponding to that allowed by the regulator. Finally, the issue does not arise under Option C because the regulator uses a trailing average regime for the entire cost of debt and regulated firms could then be expected to desist from interest rate swap contracts and thereby incur a cost of debt that closely corresponded to that allowed by the regulator.

the five-year regulatory term (and therefore the average risk-free rate used is higher) net of the transactions costs of the interest rate swaps (which are used in options A and B but not C).

In respect of criterion (6), one might expect that Option C would yield the lowest price volatility because it uses historical averages rather than prevailing rates and it applies the same averaging process to both the risk free rate and the DRP (thereby gaining risk reduction from the negative correlation between these two parameters). However this is an empirical question and Appendix 2 assesses it. Using data from 2003 to 2014, output prices would have exhibited similar variation under Options A and B and substantially less under Option C.

In respect of criterion (7), no transitional process is required to shift to Option A: one simply abandons the TCSD (because it isn't warranted) and grants an allowance to all firms for the transactions costs of interest rate swap contracts (because this is warranted). By contrast, a transitional process may be warranted for Option B, so as to switch to the use of a trailing average DRP without the need to collect historical data (because DRP figures for the last several years may not be available). The best available process is that proposed by the QTC (2012b, page 2), and commencing at the beginning of a regulatory cycle. Assuming use of a ten-year DRP (for example), for the first year, the allowed DRP would be the prevailing (ten-year) DRP at the beginning of that year, i.e., the DRP over a narrow window just before the commencement of the regulatory cycle. For the second year, the allowed rate would be 90% of the rate prevailing at the beginning of the first year plus 10% of the rate prevailing at the beginning of the second year. For the third year, the allowed rate would be 80% of the rate prevailing at the beginning of the first year plus 10% of the rate prevailing at the beginning of the second year plus 10% of the rate prevailing at the beginning of the third year, etc. The process would take ten years to complete the transition. Thus, for the tenth year and thereafter, the allowed rate would be 10% of each of the ten-year rates prevailing at the beginning of each of the previous ten years. This transitional process is simple and, as shown in Lally (2014a, section 7), leads to minimal one-off profits or losses to firms from the switch in regime. In respect of Option C, a transitional process may also be adopted in order to mirror the fact that firms would be gradually unwinding their interest rate swap contracts associated with the risk-free rate component of their cost of debt. However such a transitional process will differ from that required for the DRP component of the cost of debt.

Relative to Option B, Option C has lower variation over time in output prices but it has three disadvantages: greater incentive problems for capex and new entrants (unless these problems are addressed at the cost of greater complexity), the need for a transitional regime for the risk free rate component of the cost of debt, and the fact that it cannot in substance be implemented (because it is impossible to determine the impact that interest rate swap contracts of otherwise similar unregulated firms would have on the effective debt term of such firms). This suggests that the Option B is superior to Option C. In comparing Option A with B, Option A suffers from the disadvantage that there is no viable debt strategy that can be combined with it to satisfy the NPV = 0 principle, and it raises bankruptcy risk. However it is easier to implement, it has lesser incentive problems for capex and new entrants (or less complexity if these incentive problems are addressed), and the transitional process from the present regime is simpler. In respect of the greater bankruptcy risk, this has been examined in Appendix 2 using data from the GFC period and the increase would have been trivial. In respect of violations of the NPV = 0 principle, Lally (2010, Appendix 1) analyses this issue and finds that the violations are not substantial. Furthermore, the CDS market is likely to continue to develop and may reach the point at which the DRP risk under the present regime can be better hedged by regulated businesses, in which case these three concerns would be further ameliorated. In view of all this, I favour Option A.

In summary, I do not support use of a firm-specific TCSD because it encourages firms to lengthen their average debt term without consideration of the cost of doing so. In addition, even if firms borrow for a term that equals the regulatory cycle, an allowance for the transactions costs on interest rate swap contracts is warranted because firms stagger their borrowing arrangements. In addition, the available evidence suggests that regulated firms in New Zealand have an average debt term of about seven years rather than the ten years claimed by CEG. Finally, CEG's criteria for selecting the appropriate regulatory debt policy are too narrow and recourse to a more comprehensive set of tests leads to the conclusion that the best policy is to invoke the risk free rate at the beginning of the regulatory cycle (with a term matching the regulatory cycle) coupled with a DRP at the beginning of the regulatory cycle (with a term matching the average term for which firms borrow), plus the transactions costs of interest rate swap contracts to align the risk-free rate component of the firm's staggered debt with the regulatory cycle. This is similar to the current regime (but without the TCSD and with the transactions cost of interest rate swaps).

3. Network Strategies on the Cost of Debt

Network Strategies (2014, pp. 11-17) argues that appropriate compensation to regulated firms is achieved by matching the risk free rate and the DRP to the regulatory cycle, and therefore the TCSD is unnecessary. Stated in terms of the criteria presented in the previous section, Network Strategies are implicitly stating that this regulatory policy (matching the risk free rate and the DRP to the regulatory cycle) satisfies the NPV = 0 principle. However, this can only be true if there is a viable debt policy that can be coupled with this regulatory policy. Given that the CDS market is not sufficiently developed to allow the DRP on actual borrowings to be matched to the regulatory cycle, the only debt policy that could (in conjunction with the regulatory policy referred to here) involves borrowing at the beginning of each regulatory cycle for the term of the cycle. Such a policy involves no staggering, and therefore high refinancing risk, and is therefore unviable. Consistent with this, regulated firms do not employ such a strategy. So, Network Strategies' argument is invalid. Nevertheless, I agree with them that the TCSD should not be employed, but for reasons given in the previous section rather than for the reason offered by Network Strategies.

Furthermore, the NPV = 0 principle is only one of several important considerations in this area, as described in the previous section. Network Strategies offer no comments on any of these other considerations.

4. PwC on the Cost of Debt

PwC (2014, paras 36-38) argues that the TCSD should be displaced by a DRP allowance that reflects a prudent borrowing term rather than the term of the regulatory cycle, and therefore an allowance for the transactions costs of the interest rate swap contracts should be made. It is implicit in these comments that the prudent borrowing term would apply uniformly across all firms in the sector. Apart from the allowance for the transactions costs of the interest rate swap contracts, I agree with these comments for reasons given in the previous section. In respect of the swap contracts, and as noted in the previous section, these are required even if the prudent borrowing term has the same length as the regulatory cycle, due to the need to stagger borrowing.

5. CEG on the TAMRP

CEG (2014, section 6) argues that the TAMRP should be estimated over the same period as the risk free rate relates to, and that the best estimate over this time period is provided by the DGM version used by the AER (2013, Appendix E). This involves using the DGM to estimate the expected market return, and deduction of the prevailing five-year risk free rate (net of the tax effect) then yields the estimate of the TAMRP. Using this approach, CEG (2014, Figure 7) estimates the TAMRP at 8% in March 2014. In support of the claim that the DGM is the best methodology, CEG (2014) cites CEG (2013), who in turn judge the DGM to be the best method on the basis of tests by Li et al (2013) on US data from 1977-2011. These tests assess the ability of MRP estimates from a particular version of the DGM to predict realised excess returns (market returns net of the risk free rate) over a variety of forecasting periods up to four years. The results are statistically significant, particularly for the longer forecast periods, economically significant (in the sense of generating wide variations in the MRP estimate at different points in time), markedly superior to alternative (and widely-researched) predictors, and are not materially enhanced by combining the DGM-based predictor with any of these other predictors.

My views on these claims are as follows. Firstly, given the need to estimate the TAMRP over the next five years, the DGM used by CEG does not do so and instead estimates the expected market return out to infinity (at the same rate per year) followed by deducting the (tax adjusted) risk free rate for the next five years. Consistency would require that the DGM be used to estimate the expected market return over the next five years, in which case deduction of the (tax adjusted) risk free rate for the next five years would yield the estimated TAMRP for the next five years. The potential for significant error from failing to do this was raised in Lally (2012, section 3.2) with elaboration in Lally (2013, section 8). In response, CEG (2012b, pp. 37-41) argues that their approach is generally adopted by analysts and that doing otherwise is impractical because it requires an exogenous estimate of the long-run expected market return. Neither of these claims addresses the concern that CEG's approach is exposed to significant risk of error, and that the error is likely to be an overestimate when the prevailing risk free rate is low (as at present).

Secondly, despite relying almost exclusively on the results from Li et al (2013) in support of using the DGM to estimate the MRP, CEG do not employ the same version of the DGM as that employed by Li et al. In particular, Li et al apply their model to individual firms (and then value weight to obtain the market discount rate) rather than to the market in aggregate, use a convergence period of 15 years rather than CEG's ten years, forecast both earnings and the retention rate to generate the forecast dividends in each future year (rather than forecasting dividends directly), do not make a deduction from the long-run expected growth rate in GDP in order to estimate the long-run growth rate in dividends for existing firms, assumes that all investment is NPV zero from year 15, and (implausibly) assumes that inflation is zero from year 15.[11] CEG fail to explain why they depart from the Li et al model and, given that they do so, why the (apparent) empirical merits of Li et al's model can be extrapolated to CEG's model.

Thirdly, Li et al's analysis is performed on US rather than New Zealand data and CEG do not test either their version of the DGM or Li et al's on New Zealand data. CEG are implicitly assuming that their model would generate the best results using New Zealand data merely because Li et al's model does so using US data for 1977-2011.

Fourthly, the predictive power of this methodology in respect of excess market returns does not necessarily imply anything about the MRP because the predictive power may simply arise from market informational inefficiency. Even Campbell and Thompson (2008, page 1511), who conclude that various predictors are useful, imply that these prediction gains are a manifestation of market inefficiency rather than changes in the MRP: "We show that…investors could have profited by using market timing strategies." Clearly one cannot *profit* from investing in equities if the MRP is expected to be higher, because the higher risk premium would simply be compensation for greater risk. So the reference to "profit" implies market informational inefficiency.

Fifthly, the result of exclusive reliance upon this approach would be very significant variation in estimates of the TAMRP over relatively short periods. CEG's estimates of the TAMRP range from 7% to 12% over the period 2007-2009 (CEG, 2014, Figure 7), whilst Li et al's estimates of the MRP range from 0% to 15% over the period 1981-1983, from 2.6% to 9.4% over the period 2000-2002, and from 4.4% to 12.6% over the period 2007-2009 (Li et al,

[11] The last assumption is implicit in Li et al invoking the Gordon-Shapiro (1956) formula for the long-run expected growth rate in earnings (the product of the expected rate of return in new investment and the retention rate). The fact that this formula presumes no inflation is discussed in Lally (1988).

2013, Figure 1).[12] Such pronounced variation raises reasonable concerns about the plausibility of such estimates of the TAMRP and the MRP (especially an estimate of zero). Furthermore, such variations significantly exceed those arising from the risk free rate and therefore would give rise to more variation in output prices than the approach currently used by the Commission. Variations in output prices are not a concern if they arise from variation in the true TAMRP. However, the variation in the estimates from Li et al (2013) is implausibly high, implying that TAMRP estimates based upon such an appropriate would induce considerable unwarranted variation in output prices.

Lastly, exclusive reliance on the estimates of the TAMRP from one approach is likely to produce a less reliable estimate than from averaging over the results from a range of different approaches, particularly if these estimators are uncorrelated. Furthermore, even if one of the estimators were biased, it might still warrant significant weight. To illustrate this point, consider the following analysis. The usual criterion in selecting an estimator or combination is minimising the Mean Squared Error (MSE) of the estimate (Ferguson, 1967, page 11).[13] Letting $\hat{T}$ denote an estimator and T the true value of the parameter being estimated, the MSE of an estimator is as follows:

$$\begin{aligned} MSE &= E\left[\hat{T} - T\right]^2 \\ &= E\left[\hat{T} - E(\hat{T}) + E(\hat{T}) - T\right]^2 \\ &= E\left[\hat{T} - E(\hat{T})\right]^2 + \left[E(\hat{T}) - T\right]^2 \end{aligned} \quad (1)$$

where the first term in the last equation is the variance of the estimator and the second term is the square of the bias. Now, suppose that there are two estimators. Letting w denote the weight on the first estimator, this weight should be chosen to minimise the MSE of the weighted-average estimator:

[12] Li et al's MRP estimates involve deducting the prevailing one-month Treasury Bill rate whilst CEG deduct the five-year government bond rate in their analysis. However, even if Li et al had deducted the five year rate, their estimates would still exhibit high variation over time. For example, over the period from January 2000 to Sept 2002, they report estimates of the MRP from 2.6% to 9.4%. Adding back the prevailing US Treasury Bill rate (5.3% and 1.6% respectively), and instead deducting the prevailing five year rate (6.6% and 2.9% respectively), the results are then 1.3% and 8.1% respectively. In this case, the degree of variation is the same and the MRP estimate of 1.3% is even more implausible than their reported figure of 2.6%.

[13] The MSE is the average over the squared differences between the estimated value and the true value.

$$
\begin{aligned}
MSE &= E\left[w\hat{T}_1 + (1-w)\hat{T}_2 - T\right]^2 \\
&= E\left[w(\hat{T}_1 - T) + (1-w)(\hat{T}_2 - T)\right]^2 \\
&= w^2 E\left[\hat{T}_1 - T\right]^2 + (1-w)^2 E\left[\hat{T}_2 - T\right]^2 + 2w(1-w)Cov(\hat{T}_1, \hat{T}_2) \\
&= w^2 MSE_1 + (1-w)^2 MSE_2 + 2w(1-w)Cov(\hat{T}_1, \hat{T}_2) \qquad (2)
\end{aligned}
$$

where $Cov(\hat{T}_1, \hat{T}_2)$ is the covariance between the two estimators. Now suppose that two uncorrelated estimators are available: the historical average excess return, which is currently unbiased and has a standard deviation of 2%, and a forward-looking estimator, which is also unbiased and has a standard deviation of 2%. Using equation (1), both estimators have a MSE of $.02^2$. Using equation (2), with the covariance being zero, the MSE of a combined estimator is minimised with equal weight on the two estimators and therefore a MSE of $.014^2$. So, the MSE is reduced by 50% by optimally combining the two estimators. With three uncorrelated estimators, with the same standard deviation and each unbiased, the MSE of a combined estimator is minimised with equal weight on the three estimators and therefore a MSE of $.011^2$. So, the MSE is reduced by 70% by optimally combining them.

Suppose now that the historical average excess return were currently biased down as an estimator of the MRP over the next regulatory cycle (because economic conditions have raised the true MRP but the historical average excess return does not react quickly to such changes). Naturally, if one believed bias to exist, one could not specify the degree of bias to a high degree of precision. Nevertheless, one could consider the implications of a range of possible values for that bias. For example, suppose the bias was considered to be up to 2%. At the upper limit of 2%, and using equation (1), the MSE of the historical average excess return is $.028^2$ whilst that of the forward-looking estimator is still $.02^2$. Following equation (2), the MSE of the combined estimator is minimised with w = 0.33 (a 33% weight on the historical average excess returns and therefore a 67% weight on the forward-looking estimator) and therefore an MSE of $.016^2$, which involves a 36% reduction in the MSE relative to placing sole weight on the forward-looking estimator. With the bias at a lower level, these MSE gains are even greater. So, even with significant bias in the historical average excess return at the present time, it may still warrant significant weight in a weighted-average estimator and the combined estimator has a MSE that is significantly less than the better of the two individual estimators.

An even better goal than choosing an estimator with minimal MSE for the MRP over the next regulatory cycle would be to choose an estimator with minimal MSE for the MRP over the *life* of the regulated assets, i.e., under or over estimation within a single regulatory cycle would be of no great consequence relative to aggregate errors over the entire life of the regulated asset. With such a long period, short-term biases in the historical average excess return methodology are likely to wash out, and therefore the merits of historical averaging will be even greater than previously concluded.

The argument for averaging over results from a range of methodologies also extends to averaging over a range of different markets. Use of results from foreign markets may introduce bias, because the average of the true MRPs of these markets may differ from New Zealand. However, as shown above, bias would have to be very large before such results would warrant a very low weight.

In summary, I do not support CEG's proposal to estimate the TAMRP over the next five years using a version of the DGM primarily because such an approach produces implausibly high variation over time in the estimated TAMRP and because reliance on only one method rather than an average over several methods is likely to be less reliable. In addition, although CEG cite an empirical paper in support of their use of the DGM, the version used by CEG differs from that in the cited paper, the cited paper does not use New Zealand data, and the empirical tests carried out in the cited paper may provide evidence of market inefficiency rather than evidence in support of their model.

6. Estimating the TAMRP

6.1 Introduction

I now seek to estimate the TAMRP at the present time. The Commission uses a simplified version of the Brennan-Lally CAPM (Lally, 1992; Cliffe and Marsden, 1992), which assumes (since the introduction of dividend imputation in 1988) that all dividends are fully imputed, shareholders can fully utilise the credits, the average tax rate on dividends and interest is equal to the corporate tax rate, and capital gains are tax free. Under these assumptions, the TAMRP is as follows:

$$TAMRP = E(R_m) - R_f(1 - T_c) \tag{3}$$

where $E(R_m)$ is the expected market return exclusive of imputation credits, R_f is the risk-free rate, and T_c is the corporate tax rate. Consistent with the analysis in the previous section, I favour consideration of results from a range of methodologies and a range of countries.

6.2 Historical Averaging of Excess Returns

I start with historical averaging of excess returns for New Zealand (the "Ibbotson" approach). Using this approach with data from 1931-2002, Lally and Marsden (2004a, Table 2) estimate the TAMRP in the general version of the Brennan-Lally model at 7.2%. Correcting for the taxation assumptions underlying the simplified version of the model that apply from 1988, the result is slightly higher at 7.3%. I apply the same approach to the years 2003-2013. For each year *t*, the ex-post counterpart to the TAMRP in equation (3) is

$$TA\hat{M}RP_t = R_{mt} - R_{ft}(1 - T_c) \tag{4}$$

Consistent with Lally and Marsden (2004a), R_{ft} is the ten-year government bond rate averaged over the year with the rates taken from Reserve Bank data.[14] In respect of R_{mt}, Lally and Marsden (2004a, Appendix A) obtain this from the NZX50 Gross Index return GR_{mt} (which includes the imputation credits) as follows. Letting ICY_{mt} denote the imputation credits on the NZX50 Index return as a proportion of the equity value, D_{mt} the cash dividend yield, GD_{mt} the gross dividend yield (cash plus the imputation credits), Q_{mt} the ratio of imputation credits to cash dividends, and CR_{mt} the NZX50 Capital Index return (which excludes dividends), it follows that

$$\begin{aligned} R_{mt} &= GR_{mt} - ICY_{mt} \\ &= GR_{mt} - (GD_{mt} - D_{mt}) \\ &= GR_{mt} - \left[GD_{mt} - \frac{GD_{mt}}{1 + Q_{mt}} \right] \end{aligned}$$

[14] Table B2 on the Reserve Bank website (www.rbnz.govt.nz).

$$= GR_{mt} - GD_{mt}\left[1 - \frac{1}{1+Q_{mt}}\right]$$

$$= GR_{mt} - (GR_{mt} - CR_{mt})\left[1 - \frac{1}{1+Q_{mt}}\right]$$

Lally (2000, page 6) estimates Q_{mt} at 80% of the maximum possible rate, which is $T_c/(1\text{-}T_c)$. In addition the values for *GR* and *CR* are obtained from the New Zealand Stock Exchange.[15] The resulting value for R_m for each year is then substituted into equation (3) to yield the value for $TA\hat{M}RP$ that year. The values for these parameters and the resulting values for $TA\hat{M}RP$ are shown in Table 1 below.

Table 1: Ex-Post Values for the TAMRP 2003-2013

Year	*GR*	*CR*	T_c	*Q*	R_m	R_f	$TA\hat{M}RP$
2003	.253	.176	.33	.394	.231	.059	.192
2004	.251	.164	.33	.394	.226	.061	.186
2005	.100	.025	.33	.394	.079	.059	.039
2006	.203	.145	.33	.394	.187	.058	.148
2007	-.003	-.049	.33	.394	-.016	.063	-.058
2008	-.328	-.365	.30	.343	-.337	.061	-.380
2009	.189	.124	.30	.343	.173	.055	.134
2010	.024	-.027	.30	.343	.011	.056	-.028
2011	-.010	-.060	.28	.311	-.022	.050	-.058
2012	.242	.181	.28	.311	.227	.037	.201
2013	.165	.115	.28	.311	.153	.041	.123
Average							.045

As shown in the table, the average of these ex-post values for the TAMRP is .045. This average over 11 years is combined with the estimate of .073 for 1931-2002 (72 years), to yield the updated estimate of the TAMRP of 6.9% as follows

[15] The website is http://companyresearch.nzx.com/deep_ar/index.php?pageid=liveindex.

$$T A \hat{M} R P = .073\left(\frac{72}{83}\right) + .045\left(\frac{11}{83}\right) = .069$$

In respect of other markets the same approach cannot be adopted due to lack of data on the tax parameters that are required under this approach. An alternative is to estimate the market risk premium in the standard version of the CAPM, and then adjust for the tax parameter in equation (3). Dimson et al (2014) presents estimates of the standard market risk premium in 20 foreign markets, using data from 1900-2013.[16] With the possible exception of South Africa, they can all be regarded as 'developed' economies and therefore suitable comparators for New Zealand. The mean of these point estimates is .061 (see Table 3 below). Following equation (3), and using the current New Zealand ten-year risk free rate of .0455 (April 2014 average), the resulting estimate of the TAMRP is .073 as follows:

$$T A \hat{M} R P = .061 + .0455(0.28) = .074 \tag{5}$$

6.3 The Siegel Estimate

Siegel (1992) analyses real bond and equity returns in the US over the sub-periods 1802-1870, 1871-1925 and 1926-1990. He shows that the Ibbotson type estimate of the standard MRP (historical averaging of excess returns) is unusually high using data from 1926-1990, due to the very low real returns on bonds in that period. He further argues that the latter is attributable to pronounced unanticipated inflation in that period. Consequently the Ibbotson type estimate of the standard MRP is biased up when using data from 1926-1990. Thus, if the data used is primarily from that period, then this points to estimating the standard MRP by correcting the Ibbotson type estimate through adding back the historical average long-term real risk free rate and then deducting an improved estimate of the expected long-term real risk free rate. The same approach can be adopted to estimating the TAMRP, subject to correction for taxes. Applying this approach to New Zealand data, Lally and Marsden (2004b) obtain an estimate for the tax-adjusted market risk premium of .055-.062, using data from 1931-2002, with the range in values reflecting estimates of the long-run expected real risk-free rate of .03-.04. The latter estimate is consistent with the average yield on inflation-protected New

[16] The results presented by them uses geometric differencing rather than arithmetic differencing of annual stock and bond returns. However, geometric differencing is not consistent with the definition of the market risk premium. The result from arithmetic differencing was obtained by subtracting their average bond return from their average stock return, for each market.

Zealand government bonds since their inception in 1996, of .036.[17] Correcting these numbers, for consistency with the tax assumptions underlying the simplified version of the Brennan-Lally model used by the Commission, the result is .056-.063. I invoke the midpoint of this range, of .059.

This estimate of .059 requires augmentation by data from 2003-2013. For each year, the estimate of the Siegel-type estimate of the TAMRP is as follows:

$$T\hat{AMRP}(S)_t = T\hat{AMRP}_t + R^r_{ft}(1-T_c) - 0.035(1-T_c) \quad (6)$$

The values for $T\hat{AMRP}$ for 2003-2013 are shown in Table 1 along with the nominal risk-free rates for those years, and are reproduced in Table 2 below. Table 2 also shows CPI inflation rates for these years[18], and this is used to convert the nominal risk-free rates for these years to real rates. Substitution into equation (6) then yields the Siegel-type estimate of the TAMRP for each year, as shown in Table 2 below.

Table 2: Siegel-Type Estimates of the TAMRP 2003-2013

Year	R_f	Inf	R^r_f	$T\hat{AMRP}$	$T\hat{AMRP}(S)$
2003	.059	.016	.042	.192	.197
2004	.061	.027	.033	.186	.184
2005	.059	.032	.026	.039	.033
2006	.058	.026	.031	.148	.145
2007	.063	.032	.030	-.058	-.062
2008	.061	.034	.026	-.378	-.386
2009	.055	.020	.034	.136	.134
2010	.056	.040	.015	-.026	-.042
2011	.050	.018	.031	-.055	-.061
2012	.037	.009	.028	.203	.196
2013	.041	.016	.025	.126	.116

[17] Data from Table B2 on the website of the Reserve Bank of New Zealand (www.rbnz.govt.nz).

[18] Data from Table M1 on the website of the Reserve Bank of New Zealand (www.rbnz.govt.nz).

Average	.041

As shown in the table, the average of these Siegel-type estimates for the TAMRP is .041. This average over 11 years is combined with the estimate of .059 for 1931-2002 (72 years), to yield the updated Siegel-type estimate of the TAMRP of .057 as follows:

$$TA\hat{M}RP(S) = .059\left(\frac{72}{83}\right) + .041\left(\frac{11}{83}\right) = .057 \tag{7}$$

In respect of other markets the same approach cannot be adopted due to lack of data on the tax parameters that are required under this approach. An alternative is to estimate the market risk premium in the standard version of the CAPM**,** and then adjust for the tax parameter in equation (3). Dimson et al (2014) presents estimates of the standard market risk premium in 20 foreign markets, using data from 1900-2013. For each market, I add back the average real yield on bonds and then deduct an estimate of the expected long-term real yield on bonds. Consistent with seeking to estimate the market risk premium for New Zealand, the estimate of the expected long-term real risk free rate for New Zealand should be invoked, i.e., .035. The results are shown in Table 3 and the average is .048.

Table 3: Siegel-Type Estimates of the MRP for Foreign Markets

Country	$M\hat{R}P$	$\overline{R}_f^r$	$M\hat{R}P(S)$	$\overline{R}_m^r$
Australia	.070	.024	.059	.090
Austria	.106	.047	.118	.048
Belgium	.046	.014	.025	.053
Canada	.047	.026	.038	.071
Denmark	.037	.037	.039	.071
Finland	.092	.013	.070	.092
France	.057	.009	.031	.057
Germany	.084	.010	.059	.082
Ireland	.045	.025	.035	.067
Italy	.073	-.001	.037	.059

Japan	.079	.016	.060	.088
Netherlands	.054	.019	.038	.071
Norway	.051	.025	.041	.072
Portugal	.066	.024	.055	.087
South Africa	.075	.024	.064	.096
Spain	.040	.021	.026	.059
Sweden	.051	.033	.049	.080
Switzerland	.037	.026	.028	.062
UK	.053	.023	.041	.072
US	.063	.024	.052	.084
Average	.061		.048	.073

Converting this figure of .048 to an estimate of the TAMRP, using equation (3) and the current New Zealand ten year government stock rate of .0445 (April 2014 average), yields an estimate of .061 as follows:

$$TA\hat{M}RP = .048 + .0455(0.28) = .061 \tag{8}$$

An alternative approach to the inflation-shock issue raised by Siegel (1992, 1999) arises from Siegel's observation that the average real market return was similar across the three subperiods examined by him, leading him to conclude that the expected real market return was stable over time. Accordingly, one would estimate the expected real market return from the historical average, convert to its nominal counterpart today using a current inflation forecast, and then deduct the current risk-free rate (net of tax) in accordance with equation (3). Using data from 1900-2013, the average real market return for New Zealand was .077 (Dimson et al, 2014, Table 49). Converted to a current nominal expected market return using current expected inflation of .020 (the midpoint of the Reserve Bank's target range), the result is .099. Substitution into equation (3) along with the current New Zealand ten year government stock rate of .0445 (April 2014 average), yields an estimate for the TAMRP of .066 as follows:

$$TA\hat{M}RP = .099 - .0455(1 - .28) = .066$$

(9)

In respect of other markets, the natural course is to determine the cross-country average of the intertemporal average real market return. Dimson et al (2014) presents the average real market returns for 20 foreign markets, using data from 1900-2013, as shown in Table 3. As shown there, the average is .073. Converted to a current nominal expected market return for New Zealand using expected inflation of .020 (the midpoint of the Reserve Bank's target range), the result is .094. Converted to an estimate of TAMRP in the same way as that underlying equation (9), the result is .061.

Both of these versions of the Siegel approach seek to address the late 20th century inflation shock, but the first version deducts a long-term average of the expected real risk free rate whilst the second version deducts the current real risk free rate. Since the long-term average of the expected real risk free rate is .035 whilst the current real rate is about .020 (.0455 nominal less expected inflation of .025), the first version yields a lower estimate of the TAMRP. Furthermore, since both versions seek to address the late 20th century inflation shock, they might be considered to be alternatives rather than complementary. However, the second version has merit independent of any historical inflation shock because it assumes that the expected real market return is stable over time and this may be a better assumption than that underlying the historical averaging of excess returns (that the TAMRP is stable over time). Accordingly, results from both of these versions of the Siegel approach will be considered.

6.4 The DGM

A DGM is a model in which the expected market return is chosen such that it discounts future dividends on existing shares to the current market value of those shares. CEG (2014, section 6.3) favours a three-stage version referred to by the AER (2013, Appendix E), in which expected dividends are forecast for the first three years using Bloomberg's forecasts, and the growth rates over the next eight years are such as to cause the growth rate in the third year to converge on the long-run growth rate (applicable from year 11). Letting S_0 denote the current value of the market index, S_{11} the expected value in three years, D_t the expected dividends in year t, g the long-run expected growth rate in dividends per share (DPS) from the end of year 11, and k the market cost of equity, it follows that the current value of equities is as follows:

$$S_0 = \frac{D_1}{1+k} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + ... + \frac{D_{11}}{(1+k)^{11}} + \frac{S_{11}}{(1+k)^{11}}$$

$$= \frac{D_1}{1+k} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + ... + \frac{D_{11}}{(1+k)^{11}} + \frac{\left[\frac{D_{11}(1+g)}{k-g}\right]}{(1+k)^{11}} \qquad (10)$$

Solving (numerically) for k, and then deducting the prevailing risk free rate (net of tax), yields the estimate of the TAMRP. The expected dividends in year t constitute the "gross" dividends (cash dividends plus imputation credits at the maximum attachment rate of 0.388, consistent with the simplified version of the Brennan-Lally model that is used by the Commission). CEG's estimate of g is 4%, comprising expected inflation of 2% (the midpoint of the Reserve Bank's target range) and expected real growth in DPS of 2%, with the latter figure being the expected long-run real growth in GDP of 3% less a deduction of 1% for the net creation of new shares from new companies and new share issues (net of buybacks) from existing companies, i.e.,

$$g = [1 + (.03 - .01)][1.02] - 1 = .040$$

CEG's estimate for the expected long-run growth rate in New Zealand's GDP is drawn from the historical average for New Zealand since 1900. By comparison, Bernstein and Arnott (2003, Table 1) provide average real GDP growth rates over 16 other developed countries over the period 1900-2000, and these average 2.8% rising to 3.0% with exclusion of those countries that suffered devastation during wars. This provides support for CEG's estimate of 3% for New Zealand. In respect of the deduction of 1% for the net creation of new shares from new companies and new share issues (net of buybacks) from existing companies, Lally (2013, sections 7 and 8) examines this issue and concludes that an appropriate deduction would be 0.5-1.5%.

Equation (10) assumes that the dividends for year t are received at the end of year t. However, the dividends in year t would be received in a continuous stream throughout the year, with an average term till receipt of six months. Thus, following Pratt and Grabowski (2010, equation (4.14)), the AER reduces the term of discounting by six months in respect of each year. Accordingly, equation (10) becomes:

$$S_0 = \frac{D_1}{(1+k)^{0.5}} + \frac{D_2}{(1+k)^{1.5}} + \frac{D_3}{(1+k)^{2.5}} + ... + \frac{D_{11}}{(1+k)^{10.5}} + \frac{\left[\frac{D_{11}(1+g)}{k-g}\right]}{(1+k)^{10.5}} \quad (11)$$

Finally, the AER adjusts the model if the analysis is done part way through the financial year rather than at the beginning of the year. Following Pratt and Grabowski (2010, equation (4.18)), if the analysis done at a point such that proportion y of the year remains then equation (11) becomes:[19]

$$S_0 = \frac{D_1 y}{(1+k)^{y/2}} + \frac{D_2}{(1+k)^{0.5+y}} + \frac{D_3}{(1+k)^{1.5+y}} + ... + \frac{D_{11}}{(1+k)^{9.5+y}} + \frac{\left[\frac{D_{11}(1+g)}{k-g}\right]}{(1+k)^{9.5+y}} \quad (12)$$

Using this model, CEG (2014, Figure 6) estimate k at .1116 on 13 March 2014. Deduction of the prevailing ten-year risk free rate (one month historical average) net of the tax adjustment in accordance with equation (3) then yields an estimate of the TAMRP of .079 as follows

$$\hat{TAMRP} = .1116 - .0458(1 - .28) = .079$$

(13)

This approach assumes convergence to the long-run expected growth rate in DPS over an 11 year period, and such a convergence period is at the low end of the plausible distribution. However, longer convergence periods would lead to a higher estimate of the TAMRP and therefore this approach is conservative (as noted by CEG, 2014, para 302).

In respect of other markets, estimates determined using the same model, at approximately the same time, and drawing upon the same type of data, are not available. However, Lally (2014b, page 31) notes that, in November 2013 and using Bloomberg data, the cash dividend yield for Australia was 4.44%, and the expected growth rate in DPS for the first two years was 7.06% per year. In addition, the long-run expected growth rate in DPS is 4.6%. Substitution of these parameter values into equation (12) yields an estimate of k of .122. Substitution of this into equation (13) along with the contemporaneous Australian ten-year

[19] The AER invokes Pratt and Grabowski (2010, equation (4.18)) but this equation contains the term n instead of n-1. The test is thus: if y = 1, equation (12) must collapse to equation (11), which it does. However, Pratt and Grabowski's equation (4.18) does not then collapse to their equation (4.14).

government bond yield (November 2013 average) of .0413, the resulting estimate of the TAMRP is .092 as follows:

$$T\hat{AMRP} = .122 - .0413(1 - .28) = .092 \qquad (14)$$

As discussed in Lally (2013), such estimates are likely to be too high because they couple a prevailing estimate of the expected market return that is constant out to infinity with a prevailing risk free rate for only the next ten years. This may or may not outweigh the impact of using a short period for convergence in the expected growth rate in DPS to the long-run rate.

6.5 Surveys

The most important characteristics of survey results are that they are recent, that they are the product of very careful consideration, and that they contain results for other markets. No available survey satisfies all three requirements but the Fernandez (2013) survey satisfies the first and last requirements. The survey provides estimates of the standard MRP in 51 markets including New Zealand (ibid, Table 5). The average of the estimates for New Zealand is .054 (although based on only eight responses). Adjusted in the usual way, to provide an estimate of the TAMRP, the result is .067 as follows:

$$T\hat{AMRP} = .054 + .0455(0.28) = .067$$

Turning to the remaining 50 markets, and excluding Hong Kong because it is not a country, these could be divided into 22 advanced countries (Dimson et al's 20, plus South Korea and Singapore) and 27 others (which are all middle income countries). For each of these two subsets, the cross-country means of the within country means is .060 for the 22 advanced countries and .080 for the others. Furthermore, if the within country means are each treated as random drawings from a population, the difference in means of the two groups is statistically significant at the 99th percentile. New Zealand is clearly comparable with the first group, and I therefore invoke the cross-country average for that group, of .060. Adjusted in the usual way, to provide an estimate of the TAMRP, the result is .073 as follows:

$$T\hat{AMRP} = .060 + .0455(0.28) = .073$$

In summary, survey data for New Zealand suggests an estimate of the TAMRP of .067 whilst that for foreign markets suggests an estimate of .073.

6.6 Overall Results

The estimates discussed above are summarised in Table 4 below. I favour use of the median result both because the DDM does not produce a point estimate in the usual sense and because use of the median reduces the impact on the estimate from an extreme outcome arising from one of the methods.

Table 4: Estimates of the TAMRP with a Ten-Year Risk Free Rate

	New Zealand	Other Markets
Ibbotson estimate	6.9%	7.4%
Siegel estimate: version 1	5.7%	6.1%
Siegel estimate: version 2	6.6%	6.1%
DGM estimate	7.9%	9.2%
Surveys	6.7%	7.3%

Using only New Zealand data, the median estimate is .067. Using foreign data, the median estimate is .073. Collectively this suggests that an appropriate estimate of the TAMRP at the present time is .07, based upon the use of the ten-year risk free rate.

6.7 Estimating the TAMRP for a Five-Year Period

The estimates provided above use the ten-year risk-free rate and are therefore premised upon defining the TAMRP over the next ten years. However the typical regulatory cycle is five years and therefore estimates are now provided using the five year risk free rate.

In respect of the Ibbotson approach, using New Zealand or foreign data, a suitably long history of five years rates is not available and therefore this approach cannot be implemented. For example, five year data is only available in New Zealand since 1985. However, data is available on both five and ten-year rates in the US since 1953. This allows an approximation as follows. Firstly, the average differential for the New Zealand five and ten year rates since 1985 has been 0.07%.[20] In addition, the average differential for the US five and ten year rates over the period 1953-1985 has been 0.08%.[21] I extrapolate the latter differential to New Zealand for the same period and also to the earlier period 1931-1953. The average differential over the entire period 1931-2014 is then 0.08%. In addition the average tax rate on interest over the period since 1931 has been 0.29.[22] So, the Ibbotson type estimate for the TAMRP over the 1931-2014 period using five year risk free rates is the estimate based on ten-year rates corrected for the rate differential (after tax) as follows:

$$T\hat{AMRP} = .069 + .008(.29) = .071 \tag{15}$$

In respect of other markets, the Ibbotson-type estimate of the MRP is invoked for each foreign market (using ten-year rates), averaged over these markets (yielding 6.1%), and then adjusted using the current New Zealand ten-year rate as shown in equation (5). To convert to a five-year estimate, the Ibbotson-type estimates of the MRPs must be based upon five-year rates and the current New Zealand rate in equation (5) must be the five-year rate. In respect of the foreign MRP estimates, I use the average differential between five and ten year US rates over the period 1953-2014 to proxy for the average differential in these markets over the longer period 1900-2014. The average US differential is 0.29% (data as per footnote 21), and therefore the average MRP estimate for these foreign markets based upon the five-year risk free rate is 6.39%. Converted to an estimate of the TAMRP using the current five-year rate (April average) of .0423, the result is as follows:

$$T\hat{AMRP} = .0639 + .0423(0.28) = .076$$

[20] Data from Table B2 on the website of the Reserve Bank of New Zealand (www.rbnz.govt.nz).

[21] The rates are reported at http://research.stlouisfed.org/fred2/categories/115, and average 6.42% for the five-year constant-maturity bonds and 6.50% for the ten-year constant-maturity bonds.

[22] This comprises an average of 0.28 over the pre-imputation period 1931-1987 and an average of 0.31 since (with the latter figure corresponding to the corporate tax rate in accordance with the assumptions underlying the simplified Brennan-Lally version of the CAPM used by the Commission (see section 6.1).

In respect of the Siegel approach (version 1), using New Zealand data, this adjusts the Ibbotson estimate of the TAMRP in the fashion shown in equation (6). Changes to the two risk free rate terms in that equation (to reflect use of the five-year rates) would offset, and therefore the increment to the estimate matches that for the Ibbotson estimate, which is .002 as shown in equation (15). So, the Siegel estimate (version 1) using New Zealand data and the five-year risk-free rate is the estimate based upon the ten-year rate (.057) plus the adjustment of .002, yielding .059 as follows:

$$TA\hat{M}RP = .057 + .008(.29) = .059$$

In respect of other markets, this involves Ibbotson-type estimates for those markets, adjusted for two risk-free rates in the fashion shown in equation (6), and then converted to an estimate of the TAMRP in the fashion shown in equation (8). The first adjustment for risk free rates (to reflect use of the five-year rates) are offsetting. In respect of the MRP estimates, these are augmented by 0.29% as discussed above, to yield an average Ibbotson-type estimate of the MRP of .048 plus .0029, which is .051. Substitution of this into equation (8) along with the current five-year rate (April average) of .0423, the result is as follows:

$$TA\hat{M}RP = .051 + .0423(0.28) = .063$$

In respect of the Siegel approach (version 2), using New Zealand data, this follows equation (9) subject to using the current five-year rate (April average) of .0423, and the result is .069 as follows:

$$TA\hat{M}RP = .099 - .0423(1 - .28) = .069 \qquad (16)$$

In respect of other markets, this involves averaging the real market returns for 20 foreign markets, converting to a nominal expected rate of return for New Zealand using expected inflation of .020, and then converting to an estimate of TAMRP in the same way as that underlying equation (16). The first two steps yield a nominal expected rate of return for New Zealand of .094 as before, and substitution into equation (16) then yields .064 as follows:

$$TA\hat{M}RP = .094 - .0423(1 - .28) = .064$$

In respect of the DGM approach, the estimate in equation (13) requires substitution of the New Zealand five-year rate (over the same one month period) of .0407, and doing so raises the estimate of the TAMRP to .082. In addition the estimate in equation (14) requires substitution of the Australian five-year rate (November 2013 average) of .0346, and doing so raises the estimate of the TAMRP to .097.

In respect of surveys, the Fernandez survey that I use does not specify the risk free rate term to be used by respondents and therefore no adjustment for the use of a five rather than a ten year rate is possible. So, the results in section 6.5 are still used.

Table 5 summarises these results when the risk free rate used in the estimates is the five-year rate. As in section 6.6 I favour use of the median result.

Table 5: Estimates of the TAMRP with a Five-Year Risk Free Rate

	New Zealand	Other Markets
Ibbotson estimate	7.1%	7.6%
Siegel estimate: version 1	5.9%	6.3%
Siegel estimate: version 2	6.9%	6.4%
DGM estimate	8.2%	9.7%
Surveys	6.7%	7.3%

Using only New Zealand data, the median estimate is .069. Using foreign data, the median estimate is .073. Collectively this suggests that an appropriate estimate of the TAMRP at the present time is .07, based upon the use of the five-year risk free rates. This corresponds to the estimate currently used by the Commission.

7. Conclusions

This paper has reviewed recent submissions to the Commerce Commission on its methodology for the cost of debt and the TAMRP, and has also offered estimates of the TAMRP over both five and ten year periods. The conclusions are as follows.

Firstly, I do not support CEG's recommendation to include foreign currency denominated bonds in the DRP estimation process due to concerns about the liquidity of such bonds, other data quality issues, and the need to then determine the appropriate weights to place on different types of bonds. Lest this raise concerns about bias in estimating a firm's average DRP (over all sources), I understand that the DRPs on local currency bonds are not systematically above those on foreign-currency denominated bonds. Consequently, the use of only local-currency bonds in estimating a firm's DRP may sometimes be too high and sometimes too low but the average error will tend to zero over time.

Secondly, in choosing a target credit rating for New Zealand suppliers of UCLL/UBA services, placing sole or primary weight on Chorus's credit rating as favoured by CEG will discourage Chorus from actions that raise it credit rating and weaken its incentives to maintain its rating. Accordingly, in choosing a target credit rating for New Zealand suppliers of UCLL/UBA services, I do not favour the Commission placing sole or primary weight on Chorus's credit rating.

Thirdly, both averaging over yields on bonds with the relevant term to maturity and curve fitting are viable approaches to estimating the DRP. Since one approach is not manifestly superior (unless there are many bonds with the relevant term to maturity) and there is no necessity to favour one approach over the other, I recommend that results from both approaches be considered. In the same way, a better estimate of the MRP arises by considering estimates from a range of methodologies.

Fourthly, I do not support firm-specific use of the TCSD because it encourages firms to lengthen their average debt term without consideration of the cost of doing so.

Fifthly, even if firms borrow for a term that equals the regulatory cycle, an allowance for the transactions costs on interest rate swap contracts is warranted because firms (sensibly) stagger their borrowing arrangements. Currently, such firms do not receive that allowance.

Sixthly, the available evidence suggests that regulated firms in New Zealand have an average debt term of about seven years rather than the ten years claimed by CEG.

Seventhly, CEG's criteria for selecting the appropriate regulatory debt policy are too narrow and recourse to a more comprehensive set of tests leads to the conclusion that the best policy is to invoke the risk free rate at the beginning of the regulatory cycle (with a term matching the regulatory cycle) coupled with a DRP set at the beginning of the regulatory cycle (with a term matching the average term for which firms borrow), plus the transactions costs of interest rate swap contracts to align the risk-free rate component of the firm's staggered debt with the regulatory cycle. This is similar to the current regime (but with allowance for the transactions cost of interest rate swaps and without the TCSD).

Eighthly, I do not support CEG's proposal to estimate the TAMRP over the next five years using only a version of the DGM primarily because such an approach produces implausibly high variation over time in the estimated TAMRP and because reliance on only one method rather than an average over several methods is likely to be less reliable. In addition, although CEG cite an empirical paper in support of their use of the DGM, the version used by CEG differs from that used in the cited paper, the cited paper does not use New Zealand data, and the empirical tests carried out in the cited paper may provide evidence of market inefficiency rather than evidence in support of the DGM as a good predictor of the market risk premium.

Finally, I have estimated the TAMRP using five methods, comprising historical averaging of excess returns, correcting these returns for the 20th century inflation shock, historical averaging of real market returns coupled with the current risk free rate and expected inflation, the DGM favoured by CEG, and surveys. All five methods have been applied to both New Zealand and foreign data, and estimates are provided for both five and ten-year terms. In respect of New Zealand data and a five-year term, the estimates range from 5.9% to 8.2% with a median of 6.9%. Using foreign data and a five-year term, the estimates range from 6.3% to 9.7% with a median of 7.3%. So, even if rounded to the nearest 0.5%, an appropriate estimate is 7%, which matches that currently used by the Commission. In respect of a ten-year term, the estimates range from 5.7% to 7.9% with a median of 6.7% when using New Zealand data, and from 6.1% to 9.2% with a median of 7.3% when using foreign data. So, again, an appropriate estimate is still 7%. In all cases, whether using foreign or New Zealand data and whether estimating the TAMRP over a five or ten year term, the DGM favoured by CEG always produces the highest results and is therefore the outlier.

APPENDIX 1: Bankruptcy Risk

This Appendix estimates the increased bankruptcy risk under Option A relative to the other two options, and arising from the allowed DRP not matching that paid by the firm.

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

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

Under Option A, the allowed cost of equity is the sum of the risk free rate prevailing at the beginning of the regulatory cycle, $R_f^c(1-.28)$, and an allowed risk premium ($TAMRP\beta_e$) whilst the allowed cost of debt is the sum of the risk-free rate prevailing at the beginning of the regulatory cycle (R_f^c) and the DRP at the same point (DRP^c). In addition, firms engage in interest rate swaps to ensure that the risk-free rate component within the cost of debt paid by them matches that allowed under the current regime (R_f^c). Finally, the DRP component of the cost of debt that businesses pay would be similar to the regulatory trailing average (denoted with the superscript *TA*). So, the last equation becomes:

$$\begin{aligned} NCF &= S[R_f^c(1-.28) + TAMRP\beta_e] + B(R_f^c + DRP) - B(R_f^c + DRP^{TA}) + X \\ &= S[R_f^c(1-.28) + TAMRP\beta_e] + B(DRP - DRP^{TA}) + X \end{aligned}$$

To limit the scope of the analysis, the additional cash flows X are deleted from the analysis. In addition, the TAMRP allowed by the Commission has (with a minor exception) always been 7%. In addition, I invoke the equity beta and leverage ratio adopted by the Commission in the Input Methodologies (Commerce Commission, 2010, page 552), of 0.79 and 0.44. So, per \$100 of asset book value, the last equation becomes

$$NCF = \$56[R_f^c(1-.28) + .07(.79)] + \$44(DRP^c - DRP^{TA}) \tag{17}$$

To assess the variation in this net cash flow from the beginning of 2007 (before the GFC commenced) to the end of 2013, I have drawn upon Commission decisions for five-year BBB+ decisions from late 2009 coupled with 2008 Gas Authorisation Determination (based upon DRP estimates from early 2007). Interpolating from the 2007 to 2009 observations, the DRP was stable at about 1.3% until the beginning of 2007, rose to about 2.15% at the beginning of 2012 and declined to about 1.85% at the beginning of 2014. This is shown in the first two columns of Table 6. In addition, I assume that the average debt term is 7 years, in which case the DRP paid in each year is the seven-year trailing average, as shown in the third column of Table 6.

Table 6: The Variation in Net Cash Flow under Option A

Year	DRP	DRP^{TA}	DRP^{c}	R_f^c	NCF
2007	1.3	1.3	1.3	6.30	$5.64
2008	1.6	1.34	1.3	6.30	$5.62
2009	1.8	1.41	1.3	6.30	$5.59
2010	2.0	1.52	1.3	6.30	$5.54
2011	2.0	1.62	1.3	6.30	$5.50
2012	2.15	1.74	2.15	3.36	$4.63
2013	2.10	1.85	2.15	3.36	$4.58
2014	1.85	1.93	2.15	3.36	$4.55

TA = Trailing Average; C = Current; NCF = Net Cash Flow

I start by considering businesses for which a (five year) regulatory cycle begins in January 2007. In this case the DRP allowed under the current regime is shown in the fourth column of Table 6, i.e., 1.3% for 2007-2011 (because this was the prevailing rate at the beginning of 2007), followed by 2.15% for 2012-2016 (because this was the prevailing rate at the beginning of 2012). The fifth column of Table 6 shows the allowed risk free rate, being 6.30% for 2007-2011 (corresponding to the average five-year rate in January 2007) and 3.36% for 2012-2016 (corresponding to the average five-year rate in January 2012). The last column of Table 6 then shows the results for equation (17) in dollars per $100 of regulatory asset book value. As shown there, there is moderate variation in this NCF: it falls by up to 19% during the last three years but this is not because the allowed DRP fails to cover the DRP incurred. Instead, it is due to the allowed cost of equity falling (due to the fall in the risk free rate), and this is in fact partly offset by the allowed DRP exceeding that incurred during this period. Bankruptcy risk arises from the allowed DRP failing to cover that actually incurred, and this occurs from 2008-2011 with the largest shortfall occurring in 2011 (just before the DRP is reset in 2012). However, per $100 of asset base, the shortfall is only $0.14 (the allowed DRP of 1.3% less that incurred of 1.62%, on $44 of debt), and this shortfall represents only 2.5% of the net cash flow of the business, i.e., the shortfall on debt is dwarfed by the allowed cost of equity. Thus, for firms who have a regulatory cycle commencing in 2007, the bankruptcy risk from Option A over the period since 2006 would have been inconsequential.

These calculations assume that a regulatory cycle commences in January 2007. However the commencement point might be at other times. So, calculations of the type shown in Table 6 are therefore performed for firms with a regulatory cycle commencing in January 2008, January 2009, January 2010, and January 2011. For each of these other four cases, the bankruptcy risk is even smaller than in Table 6. So, regardless of when a firm's regulatory cycles occur, the bankruptcy risk since 2006 arising from the allowed DRP being less than that incurred is inconsequential.

In summary, under Option A, the allowed DRP may be less than that incurred by a firm thereby raising the risk of bankruptcy. However, over the period since 2006 and regardless of when a firm's regulatory cycles commence, the maximum cash flow shortfall of this type would have been only 2.5% of the cash flows arising from the allowed cost of equity. Thus, Option A would not have given rise to any material bankruptcy risk for regulated businesses since 2006.

APPENDIX 2: Variation in Output Prices Over Time

This Appendix examines the overall impact of changes in the DRP and the risk-free rate on output prices, under a variety of possible regulatory regimes, as follows.

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

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

Under Option A, the allowed cost of equity is the sum of the risk free rate prevailing at the beginning of the regulatory cycle, $R_f^c(1-.28)$, and an allowed risk premium ($TAMRP\beta_e$) whilst the allowed cost of debt is the sum of the risk-free rate prevailing at the beginning of the regulatory cycle (R_f^c) and the DRP at the same point (DRP^c). So, the last equation becomes:

$$REV = S[R_f^c(1-.28) + TAMRP\beta_e] + B(R_f^c + DRP^c) + Y$$

To limit the scope of the analysis, the additional cash flows *Y* are deleted from the analysis. In addition, the TAMRP allowed by the Commission has (with a minor exception) always been 7%. In addition, I invoke the equity beta and leverage ratio adopted by the Commission in the Input Methodologies (Commerce Commission, 2010, page 552), of 0.79 and 0.44. So, per $100 of asset book value, the last equation becomes

$$REV = \$56[R_f^c(1-.28) + .07(.79)] + \$44(R_f^c + DRP^c) \quad (18)$$

Since output variations are reflected in *Y*, this formula will reflect variation over time in output prices due to variation in the allowed cost of capital. To assess this variation from before the beginning of the GFC (in 2007) to the end of 2013, I have drawn upon the DRP data shown in Table 6 along with risk free rate data (averaged over January for the relevant year). So, for businesses with regulatory cycles beginning in January 2007 and January 2012, I determine the results from equation (18) for the regulatory cycles commencing at the beginning of 2007 (before the GFC) and at the beginning of 2012. These results are as follows:

$$REV(2007) = \$56[.063(1-.28) + .07(.79)] + \$44(.063 + .013) = \$8.98$$
$$REV(2012) = \$56[.0336(1-.28) + .07(.79)] + \$44(.0336 + .0215) = \$6.88$$

By contrast, had a trailing average regime for the DRP been used (Option B), the DRP of .0215 prevailing at the beginning of 2012 would have been replaced by the contemporaneous ten-year trailing average of .0174 (see Table 6) and the results would have been as follows:

$$REV(2007) = \$56[.063(1-.28) + .07(.79)] + \$44(.063 + .013) = \$8.98$$
$$REV(2012) = \$56[.0336(1-.28) + .07(.79)] + \$44(.0336 + .0174) = \$6.70$$

By contrast, had a trailing average regime for both the DRP and the risk-free rate been used in setting the allowed cost of debt (Option C), the risk-free rates of 0.059 and 0.038 prevailing at the beginning of 2007 and 2012 respectively would have been replaced by the contemporaneous five-year trailing averages of 0.0594 and 0.0487 respectively and the results would have been as follows:[23]

$$REV(2007) = \$56[.063(1-.28) + .07(.79)] + \$44(.0594 + .013) = \$8.82$$
$$REV(2012) = \$56[.0336(1-.28) + .07(.79)] + \$44(.0487 + .0174) = \$7.36$$

These results along with those for regulatory cycles with different start dates are shown in Table 7 below. For each of these three regulatory regimes, there are seven changes in the revenues of the regulated business, from which the standard deviation (as a measure of variation) can be estimated. For Options A, B, and C, these standard deviations are \$1.46, \$1.48 and \$0.92 respectively. Thus, across these three possible regulatory regimes, output

[23] The trailing averages used for both the DRP and the risk-free rate are averages over the prevailing month (January) and the previous five Januaries. Other averaging schemes are possible (involving the past five years) but the volatility results are likely to be very similar under alternative such schemes.

prices would have exhibited similar variation under Options A and B and substantially less under Option C.

Table 7: Variation over Time in Output Prices for Various Regulatory Cycles

Cycle	First REV	Second REV	Third REV
2007-2011 (A)	$8.98 (2007)	$6.88 (2012)	
2007-2011 (B)	$8.98 (2007)	$6.70 (2012)	
2007-2011 (C)	$8.82 (2007)	$7.36 (2012)	
2008-2012 (A)	$8.55 (2003)	$9.71 (2008)	$6.46 (2013)
2008-2012 (B)	$8.55 (2003)	$9.60 (2008)	$6.36 (2013)
2008-2012 (C)	$8.71 (2003)	$9.23 (2008)	$6.86 (2013)
2009-2013 (A)	$8.55 (2004)	$7.29 (2009)	$7.42 (2014)
2009-2013 (B)	$8.55 (2004)	$7.12 (2009)	$7.45 (2014)
2009-2013 (C)	$8.74 (2004)	$7.91 (2009)	$7.41 (2014)
2010-2014 (A)	$8.76 (2005)	$8.48 (2010)	
2010-2014 (B)	$8.76 (2005)	$8.27 (2010)	
2010-2014 (C)	$8.73 (2005)	$8.42 (2010)	
2011-2015 (A)	$8.53 (2006)	$7.86 (2011)	
2011-2015 (B)	$8.53 (2006)	$7.70 (2011)	
2011-2015 (C)	$8.60 (2006)	$8.07 (2011)	

In summary, the variation over time in output prices has been assessed under Options A, B, and C. Using data from 2003 to 2014, output prices would have exhibited similar variation under Options A and B and substantially less under Option C.

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