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EXECUTIVE SUMMARY

The Commerce Commission has recently issued draft decisions on RAB indexation and the cost of capital for the Input Methodologies. In response submissions have been received on the asset beta of network businesses, the asset beta of airfields, the TAMRP, RAB indexation, and the cost of debt. This paper has reviewed these submissions. I agree with a number of points raised in the submissions but there are only two points at which these submissions might support a change in the Commission's proposed course of action.

The first of these is Vector's proposal for inflation indexation of the RAB to use the expected inflation rate rather than the actual inflation rate. The use of the expected inflation rate has three advantages over use of the actual inflation rate: it removes the bankruptcy risk to businesses arising from actual inflation being less than forecast inflation, it eliminates any violations of the NPV = 0 principle due to regulators' errors in estimating expected inflation, and it reduces the effort that needs to be devoted to correctly estimating the expected inflation rate because errors in doing so no longer induce violations of the NPV = 0 principle. The only drawback is that the RAB will evolve over time in accordance with expected inflation rather than actual inflation. Thus the real expenditures by consumers will be affected by inflation shocks. However, such errors apply to only a single regulatory cycle and will tend to net out over a succession of regulatory cycles. The same is true of the bankruptcy risks and violations of the NPV = 0 principle arising from errors in estimating the expected inflation rate. So, the advantages and disadvantages are both small but the advantages outweigh the disadvantages. I therefore favour Vector's proposal.

Secondly, and in relation to the Commission's proposal to deal with inflation risk for Transpower (which is not currently subject to RAB indexation) by adjusting revenues by the difference between actual and expected inflation applied to the RAB, Transpower's point that the cost of debt is set in nominal terms and therefore cannot be adjusted ex-post for differences between actual and expected inflation is correct. The consequence of this is that, under Transpower's present regime, inflation that is larger (smaller) than expected reduces (enlarges) the real cash flows received by capital suppliers in aggregate and both debtholders and shareholders are affected in the same direction. So, both face real risk. By contrast, under the proposed regime, the adjustment protects the real cash flows to capital suppliers in aggregate from inflation shocks but, since payments to debtholders are fixed in nominal terms,

debtholders benefit (suffer) ex-post from lower (higher) than expected inflation and shareholders would therefore be placed in the opposite situation (benefiting if inflation is higher than expected and suffering if inflation is lower than expected). So, the Commission's proposal would not affect the inflation risks faced by debtholders and only mildly reduce the inflation risks faced by shareholders. This undercuts the rationale for the Commission's proposal. One possible solution would be for firms to borrow using indexed debt (which may not be feasible). Another possible solution would be for the Commission to inflation adjust only the equity component of the RAB.

1. Introduction

The Commerce Commission (2016a, 2016b) has recently issued draft decisions on RAB indexation and the cost of capital for the Input Methodologies. In response submissions have been received on the asset beta of network businesses, the asset beta of airfields, the TAMRP, RAB indexation, and the cost of debt. This report analyses these arguments.

2. The Asset Beta of Network Businesses

In response to claims in Lally (2016b, section 4) that HK (2016a, section 3) mistakenly use data from electricity and gas distribution businesses rather than the entire electricity and gas sectors, HK (2016b, section 3.1) respond that this was intentional so as to assess the relative betas of gas and electricity distribution businesses. I accept this statement, despite the ambiguity in HK (2016a, section 3) on this matter.[1] So, as shown in HK (2016a, Table 6), theta (the extent to which differences in income elasticities of demand for gas and electricity, adjusted for the proportion of revenues arising from variable charges, translate into differences in betas) need only be 0.17 in order for a beta differential of 0.10 for gas distribution over electricity distribution to be achieved. HK believes that this supports a beta differential of at least 0.10. However, the following contrary considerations exist.

Firstly, as discussed in Lally (2016b, page 52), income elasticities of demand (adjusted for the proportion of revenues arising from variable charges) are part of a large set of factors that affect the sensitivity of returns on an asset to real GDP shocks, and returns are also influenced by several other shocks. So there are no clear grounds to believe that the differences in income elasticities of demand (adjusted for the proportion of revenues arising from variable charges) would induce a beta increment of at least 0.10. Lally (2016b, pp. 52-55) discusses this issue and provides an example in which the value for theta is only 0.18, i.e., only marginally above the level giving rise to a beta increment for gas of 0.18. HK (2016b,

[1] HK (2016b, section 3) identifies two errors in earlier analysis by Lally (2016b, section 4) and then proceeds to correct those two errors, leaving the impression that HK's analysis is otherwise identical and therefore also applies to gas pipeline and electricity lines businesses rather than just gas and electricity distributors. Furthermore, although HK (2016b, section 3) does repeatedly refer to GDBs in this section, it also refers on three occasions to GPBs, leaving the impression with me that the references to GDBs were typos. Furthermore, even Oxera (2016, Table 3.3) has mistakenly interpreted HK's analysis as applying to all gas pipeline businesses rather than only distributors.

section 3) do not comment upon this example and therefore can be presumed not to be disputing it.

Secondly, included amongst the additional factors referred to by Lally (2016b, page 52) that affect the sensitivity of returns on an asset to real GDP shocks is regulation, and price cap regulation (which distribution businesses are subject to) would dilute the effect of a higher income elasticity of demand upon beta, i.e., price cap regulation reduces the value of theta and, the shorter the regulatory cycle, the greater the reduction. Neither HK (2016a, section 3) nor HK (2016b, section 3) discuss this point. For example, absent regulation, the value of theta might be 0.20 (and therefore warrant a beta increment for gas of at least 0.10) but price cap regulation might reduce it to 0.10, which would undercut the case for the beta increment of at least 0.10.

Thirdly, the Commission is required to estimate the betas for gas transmission, electricity transmission, gas distribution and electricity transmission. If the beta for electricity distribution is considered to be 0.34, and the margin for gas distribution over electricity distribution is considered to be 0.10, this provides beta estimates for only two of the four types of businesses. A consistent approach would require estimating the income elasticity of demand for the gas transmission businesses and using this to estimate their beta relative to gas distribution businesses. Consistency would also require estimating the income elasticity of demand for the electricity transmission businesses and using this to estimate their beta relative to electricity distribution businesses. Neither HK (2016a, section 3) nor HK (2016b, section 3) do so, and any attempt to do so would be even more difficult than assessing a beta differential for all gas network businesses relative to all electricity network businesses because three differentials rather than one would have to be estimated (gas distribution versus electricity distribution, electricity transmission versus electricity distribution, and gas transmission versus gas distribution).

Fourthly, the Commerce Commission (2016b, para 263) have elected not to apply a beta increment for businesses subject to price cap regulation relative to those subject to revenue cap regulation, despite strong theoretical grounds for such an increment, because the empirical literature does not provide any clear evidence of a differential. Plausibly, the differential exists but there is too much noise in the empirical data to identify it. Consistency requires the same approach to the question of a beta differential for gas over electricity

businesses. Since there is no clear empirical evidence of such a differential for gas over electricity, the Commission ought not to allow one.

Collectively, these four points lead me to conclude that a beta uplift of 0.10 for gas over electricity distribution businesses should not be allowed. Furthermore, I consider that 0.10 is the lowest level at which estimation of this parameter is possible.

HK (2016b, section 3.2) reject evidence on income elasticities of demand from foreign markets relative to that in New Zealand on the grounds that features of the foreign markets are significantly different to New Zealand. In so far as these features of the foreign markets are significantly different to New Zealand, I think HK's point is reasonable. However, since I have not referred to these foreign estimates of income elasticity of demand in my earlier analysis, HK's point does not undercut the conclusions in my earlier analysis.

HK (2016b, section 3.4) notes the Commerce Commission's (2016b, para 365) view that the income elasticity of demand may not have a "material impact" on beta, expresses this as the Commission casting doubt on the relevance of the income elasticity of demand to beta, and then critiques the latter position as wrong. However, HK have misrepresented the Commission's position from the effect possibly being 'not material' to the effect possibly being zero, and then proceeded to critique the latter. The problem here is not the Commission's view but HK's misrepresentation of it.

HK (2016b, section 3.5) objects to the Commission changing its view on the question of a beta differential for gas despite the fact that "the underlying evidence remains the same" over the period from my first analysis of the issue (Lally, 2004, 2008) to the present time. However, as discussed in Lally (2016a, page 6), the underlying evidence has changed from a situation in which the gas businesses were not subject to formal control (at which point I favoured the differential of 0.1) to the present situation in which they are subject to formal control. The effect of this change is to weaken the impact of growth options on beta, and also to weaken the impact of the income elasticity of demand upon beta through the periodic resetting of prices to reflect demand shocks. Accordingly, the argument for a beta uplift of 0.10 for gas businesses is undercut.

HK (2016b, section 3.5) claims that new evidence relating to the income elasticities of demand for gas and electricity (that in HK, 2016b, section 3.1) has strengthened the case for a beta uplift for the gas businesses. Relative to the situation in which the income elasticities of demand for gas and electricity were not examined, HK's point is correct. However, there are two effects operating here: the switch to formal price control (which weakens the case for the beta uplift) and HK's analysis on income elasticities of demand for gas and electricity (which strengthens the case for the beta uplift). Thus, notwithstanding the fact that HK's new evidence does strengthen the case for a beta uplift, it does not follow that the new evidence presented by HK on income elasticities is sufficiently strong to support a beta uplift. For the four reasons given above, I do not believe that this threshold has been reached.

HK (2016b, section 3.5) notes the Commerce Commission's reference to regulatory decisions in other countries and argues that their relevance is weakened because the gas markets are different from New Zealand and these foreign regulators were not presented with evidence on the income elasticities of demand for gas and electricity. These are reasonable points, but they do not undercut my earlier conclusions because I have never referred to these foreign regulatory decisions.

Oxera (2016, section 3) repeats many of the points raised by HK (2016a, section 3; 2016b, section 3). Furthermore, amongst Oxera's new material, much of it is dominated by the analysis in HK (2016b, section 3). In particular, the material in Oxera (2016, pp. 26-30) on demand risk is dominated by the income elasticity of demand estimates for gas and electricity businesses by HK (2016a, section 3). So, I focus upon material in Oxera that is both new and not dominated by that in HK. Firstly, Oxera (2016, Figure 3.5) shows that HK's (2016a, section 3) estimate for the income elasticity of demand for gas by New Zealand residential customers is not extremely large by comparison with other countries despite being large relative to that of electricity demand from New Zealand residential customers, and this adds to the credibility of HK's estimates. However, since I have not challenged the credibility of HK's estimates for the income elasticity of demand for gas and electricity in the course of concluding that a beta uplift for gas is not warranted, the enhanced credibility of HK's estimates does not change my conclusion.

Secondly, in response to my earlier argument that formal price control reduces the value of growth options, and hence the extent to which the value of the growth options of gas

businesses exceed those of electricity businesses, and therefore the extent to which the betas for gas businesses exceed those of electricity businesses (Lally, 2016a, page 6), Oxera (2016, page 35) argues that such growth options still exist. However, Lally (ibid) argues only that regulation weakens the value of the options, and therefore Oxera's response is irrelevant. Since the point may not be clear, I elaborate on it as follows. In the event of a very favourable demand shock, gas businesses may expand their networks, thereby increasing gas consumption indefinitely. Absent regulation, the consumption increment for an indefinite period boosts the net cash flows of the businesses for an indefinite period. By contrast, in the presence of a price cap, the net cash flow boost is curtailed once the current regulatory period expires (in 2.5 years on average), because the price cap would be reduced at that point to neutralize the benefit from the increased demand. So, price cap regulation curtails the value of the growth options, and hence the beta increment for gas over electricity businesses.

Thirdly, Oxera (2016, section 3.3.2) argues that stranding risk is greater for regulated gas businesses than regulated electricity businesses in New Zealand, because the viability of the businesses rests on increasing the customer base, adverse GDP shocks may curtail such growth and even induce some gas customers to disconnect and switch to electricity, thereby raising prices in accordance with the regulatory process, leading to further loss of customers, and eventually to stranding. Since such stranding risk is partly systematic, the betas of regulated gas businesses must be higher than regulated electricity businesses. I agree with this reasoning but nothing in it implies that the beta increment for gas businesses is sufficiently large to warrant an uplift of 0.10. The ultimate arbiter here is empirical evidence on betas, there are too few New Zealand businesses to supply such evidence, and foreign beta estimates do not support such an increment (possibly because they are drawn from markets in which some relevant features of the markets differ from those in New Zealand).

3. The Asset Beta of Airfield Operations

Uniservices (2016) critiques a number of the arguments presented by the Commerce Commission (2016, paras 393-422) in support of an estimate for the asset beta of airfield operations below that of the average beta of the comparator companies. The first of these is the Commerce Commission's (2016b, para 417) claim that the cross-sectional regression of the asset beta against the proportion of aeronautical revenues yielded a negative relationship and therefore that the estimated beta of a business with only aeronautical revenues would be

significantly below 0.63. In response, Uniservices (2016, section 2.2.1) identifies two errors in the Commission's representation of the data in its Figure 8, reports that correction of those errors yields a positive rather than a negative relationship between beta and aeronautical revenues, and also that the sign of the relationship is not statistically significant. I consider that the most important point here is that the estimated relationship between asset beta and aeronautical revenue is not statistically significant. Furthermore, even without accepting the data errors identified by Uniservices, the negative relationship alleged by the Commission was presumably not statistically significant either. So, regardless of whether the Commission has erred over data, this evidence does not warrant any material weight in either direction.

The second issue is the Commerce Commission's (2016b, para 417) reference to estimated equity betas for AIAL and its regulated activities (and leverage) sourced from Deutsche Bank, which the Commission converts into estimated asset betas of 0.51 and 0.46 respectively. Uniservices (2016, section 2.2.2) argues that the formula used by the Commission to convert the equity betas into asset betas ought to have been that used by Deutsche Bank, it is likely that Deutsche Bank used the "standard textbook" degearing formula, and therefore that the estimated asset betas are 0.56 and 0.51 respectively. I agree with all of this but the result is exactly the same as in the Commission's analysis: the estimated asset beta for AIAL's regulated activities is less than that of AIAL in aggregate by 0.05. Given this, I fail to understand why Uniservices has even raised this issue. Uniservices (2016, section 2.2.2) also argues that Deutsche Bank's conclusions should be viewed cautiously because the analysis underlying their estimate of the asset betas and the leverage are not revealed. I agree with the comment about the asset betas but not that concerning leverage; Deutsche Bank's view on leverage for AIAL affects its estimates of the equity betas of the various parts of AIAL's business rather than the asset betas (because the equity betas here are derived from the asset betas rather than vice versa), and only the asset betas matter for the present purposes. Uniservices also notes that the Deutsche Bank analysis is only that of one broker, and therefore should be treated with caution. However, the Commerce Commission (2016b, para 417) does refer to a second case: PwC's (2011, page 74) view that the asset beta of Queenstown Airport's aeronautical business is 0.60 and that of its commercial activities is 0.60 – 0.80. Furthermore, PwC (2011, page 33) estimates the value weight on the unregulated activities at 0.53 – 0.55. Taking midpoints of the last two parameter estimates, the estimated asset beta of the airport is 0.65 as follows:

$$\beta_A = w_R\beta_R + (1-w_R)\beta_U = 0.46(0.60) + 0.54(0.70) = 0.65$$

So, the differential between the asset beta of the airport and its aeronautical activities is 0.05, which exactly matches Deutsche Bank's view on AIAL.

The third issue relates to analysis in Lally (2016a, page 26), relating to my use of data on the proportion of non-aeronautical activities of the airport businesses, leading to an estimate of the deduction required from the asset beta of an airport in order to estimate that for aeronautical activities of 0.03. Uniservices (2016, section 2.2.3) argues that my calculation contains an error and that the appropriate deduction is not 0.03 but less. Uniservices is correct on this point, and the deduction should have been 0.01 rather than 0.03. Given my conclusion that estimates of this parameter do not warrant much confidence due to the imprecision with which underlying parameters were estimated, the practical consequences of my error are minimal. Furthermore, the Commerce Commission (2016b, Table 8 and para 404) presents updated estimates for two of the underlying parameters in my earlier analysis: an estimate of 60% rather than 61% for the proportion of revenues from aeronautical activities and an estimated average asset beta for airports of 0.63 rather than 0.65. With these two new parameter estimates, in conjunction with my earlier estimate of 0.67 for the asset beta of non-aeronautical activities, Uniservices estimates the asset beta for aeronautical activities at 0.60, which is 0.03 less than that for airports. So, with the updated data, the result of 0.03 matches my earlier estimate.

The fourth point relates to the Commerce Commission's (2016b, para 416) use of value rather than revenue weights for unregulated activities in order to estimate the beta for the regulated activities. Uniservices (2016, section 2.2.4) critiques the inconsistency in the Commission's use of data on the value weights for AIAL and Queenstown Airport in conjunction with the average asset beta for a wider set of airports. I agree with Uniservices on this point. However, there is an alternative way in which the data on the value weights for unregulated activities can be used. These value weights for unregulated activities at AIAL and Queenstown are 80% and 55% respectively (Commerce Commission, 2016b, para 416). In addition, the revenue weights for these activities are 47% for AIAL (ibid, Table 8) and 44% for Queenstown (PwC, 2011, Table 27). So, on average, the value weights exceed the revenue weights by 22%. So, across the wider set of airports examined by the Commerce

Commission (2016b, paras 393-422), with an average estimated asset beta of 0.63 and a revenue weight for unregulated activities of 40%, an estimate for the value weight for the unregulated activities is then 40% + 22% = 62%. Using the approach in Lally (2016a, section 2.3), in conjunction with the average asset beta of 0.63 for the airports considered by the Commission and the estimate of 0.67 for the asset beta of the unregulated activities, the resulting estimate for the asset beta of the regulated activities is 0.56

$$\beta_A = w_R\beta_R + (1-w_R)\beta_U: \quad 0.63 = 0.38(0.56) + 0.62(0.67)$$

This estimated asset beta of 0.56 is 0.07 less than that for the airports, which is almost identical to the figure of 0.08 obtained by the Commerce Commission (2016b, para 416). So, when appropriately using the value weight data presented by the Commission, the result is essentially the same as that of the Commission.

The fifth point raised by Uniservices (2016, section 2.2.5) is that PwC (2011, page 74) estimates the asset beta for Queenstown Airport's aeronautical activities at 0.60 whilst the Commerce Commission estimates the average asset beta of a set of airports at 0.63, implying a differential of only 0.60. However, any comparison of the asset beta of airports with the betas for aeronautical services should use the same set of firms, and Uniservices' comparison lacks this desirable feature. Ironically, Uniservices (2016, section 2.2.4) critiques the Commission for the same behaviour, as discussed in the previous paragraph. PwC (2011) estimate the beta of the unregulated activities of Queenstown Airport at 0.60 – 0.80 (ibid, page 74), and the value weight on the unregulated activities at 0.53 – 0.55 (ibid, page 33). As shown above, this implies an estimated asset beta for the airport of 0.65. So, the differential between the asset beta of Queenstown Airport and its aeronautical activities is 0.05 rather than 0.03, and the figure of 0.05 matches the estimate applied by the Commission to AIAL.

In summary, across these five points, four support the Commission's position whilst the fifth is essentially neutral. However, the Commission's proposed deduction of 0.05 is below the minimum deduction of 0.01 that I would apply to beta issues (as discussed in the previous section). Thus, my view is that the deduction (if one is to be made) should be 0.10 or some multiple of it.

4. The TAMRP

Uniservices (2016, section 3.2.1) reviews the estimates of the TAMRP presented in Lally (2015a, Table 4) and argues that the Ibbotson estimate using data from foreign markets has been underestimated by almost 1%. The TAMRP is a parameter that arises within the Brennan-Lally CAPM (Lally, 1992; Cliffe and Marsden, 1992). The Ibbotson estimate of this parameter is a historical average over the ex-post counterpart of this parameter for each of a series of years. Letting R_m denote the rate of return on the market portfolio, D_m the taxable dividend yield on that portfolio, R_f the risk-free rate, T_m the tax rate on cash dividends net of that on capital gains, and T_I the tax rate on interest net of that on capital gains, the Ibbotson estimate of the TAMRP is the time-series average of the following:

$$R_{mt} - D_{mt}T_{mt} - R_{ft}(1-T_{It})$$

As noted in Lally (2015a, section 7.1) the Commission uses a simplified version of the Brennan-Lally CAPM in which all dividends are assumed to be fully imputed (if dividend imputation operates), all shareholders can fully utilise the imputation credits, the average tax rate on dividends and interest is equal to the corporate tax rate, and capital gains are tax free. Letting T_{ct} denote the corporate tax rate in year t, the Ibbotson estimate of the TAMRP in this simplified model is the historical average of the following:

$$R_{mt} - R_{ft} + R_{ft}T_{ct} \qquad \text{if imputation operates} \qquad (1)$$

$$R_{mt} - R_{ft} + (R_{ft} - D_{mt})T_{ct} \qquad \text{otherwise} \qquad (2)$$

Lally (2015a, section 7.2) applies this process to estimate the TAMRP using New Zealand data. In respect of other markets, the same approach cannot be adopted due to lack of data on the tax regimes and parameters applicable in each of those countries over the relevant historical period (since 1900). So, Lally (2015a, section 7.2) determines the cross-country average of the estimates of the market risk premium in the standard version of the CAPM, which corresponds to the first two terms in equation (1), and then adds the current New Zealand value of the remaining term in equation (1), which is .008, thereby generating an estimate for the current value for the TAMRP for New Zealand of .070. In response, Uniservices (2016, section 3.2.1) argues that this final adjustment exhibits substantial

fluctuations and the better approach is to instead add the New Zealand historical average over the final term in each of equations (1) and (2), which is .017, thereby yielding an estimate of the TAMRP of .079 rather than .070.[2]

It is uncontroversial that the approach in Lally (2015a, section 7.2) yields greater fluctuations than that proposed by Uniservices, but the purpose of the exercise is to obtain the 'best' estimate of the current TAMRP rather than the most stable estimate over time. A better argument in support of the Uniservices approach is that the desired adjustment is the cross-country and historical average of the last term in each of equations (1) and (2), and the use of historical New Zealand data is the best available proxy. Prima facie, this is an appealing argument. However, the historical average over the final terms in equations (1) and (2) using New Zealand data is likely to be a very poor proxy for the results using foreign data because the tax regime in New Zealand over this period (1931-2014) is likely to have been quite different to most of these other countries. In particular, unlike most of these other countries, dividend imputation operated in New Zealand from 1988 onwards and this removes the dividend yield term shown in equation (2) for these years. In addition, the majority of dividends received by New Zealand investors over the pre-imputation period were tax free (Lally and Marsden, 2004a, Table 1, column 6), thereby reducing the dividend term in equation (2). To demonstrate the impact of these features of the New Zealand situation, consider a country in which dividend imputation did not operate and all dividends and all interest were taxable over the entire historical period examined. Letting d_{mt} denote the dividend yield on the market portfolio for year t, the last term in equations (1) and (2) would then be as follows:

$$(R_{ft} - d_{mt})T_{ct}$$

Using the New Zealand data on these three parameters that underlies the analysis in Lally and Marsden (2004a), the value of this term is (0.067 – 0.047)(.28) = 0.006. This is very close to the figure of 0.008 in Lally (2015a, section 7.2), and therefore rebuts the adjustment of 0.017 proposed by Uniservices (2016) in so far as these foreign markets have the tax features described above (no imputation and both dividends and interest fully taxable over the relevant historical period). I am not acquainted with the exact nature of the tax regimes in

[2] Uniservices (2016, page 22) claims that they are adding back the historical average R_fT_c for New Zealand but this is not in fact the case. For the purpose of assessing the New Zealand historical average of the last terms in equations (1) and (2), Uniservices' actual estimate is appropriate.

each of the foreign markets in question over the relevant historical period. However, even if the average lies midway between the example just considered (with an adjustment term of 0.006) and the New Zealand situation (with an adjustment term of 0.017), the average of these last two figures (0.011) would still be closer to the figure of 0.008 in Lally (2015a, section 7.2) than the figure of 0.017 proposed by Uniservices (2016). I therefore conclude that, whilst neither of these latter two approaches is satisfactory, that in Lally (2015a, section 7.2) is less unsatisfactory at the present time.

Uniservices (2016, section 3.2.2) proposes the same type of correction to the Siegel version 1 estimate of the TAMRP using foreign data. The preceding analysis therefore also applies here, and again supports the estimate in Lally (2015a, section 7.3) rather than that in Uniservices (2016, section 3.2.2).

Uniservices (2016, section 3.2.3) argues that survey responses on the market risk premium in the standard version of the CAPM should be converted into an estimate of the TAMRP using the risk-free rate prevailing at the time of the survey rather than at the time the TAMRP estimate was undertaken. However the difference in timing is only a few months and the effect on the estimate of the TAMRP only 0.1% for New Zealand and 0.2% using foreign data. These effects are inconsequential.

Frontier Economics (2016b, section 4.1) argues that TAMRP estimates from surveys do not warrant any weight, and refers to Frontier Economics (2016a) for its reasoning. These arguments have been critiqued in Lally (2016c, section 3). Since Frontier (2016b) does not respond to them, it presumably has no defence to offer.

Frontier Economics (2016b, section 4.1) also argues that the Siegel version 1 estimator should not be used, for reasons outlined in their Appendix. These arguments are addressed below, and do not warrant disregarding of the Siegel 1 estimator.

Frontier Economics (2016b, section 4.1) supports the use of the DGM, Ibbotson and Siegel 2 estimators, whilst rejecting the Siegel 1 method and survey evidence as noted above. However, these three methods favoured by Frontier generate the three largest estimates of the TAMRP across these five possibilities (Lally, 2015, Table 4). The probability of such an

event occurring by chance is only 10%, which is strongly suggestive of Frontier's choice of methods being self-interested.[3]

Frontier Economics (2016b, section 4.2) critiques the Commerce Commission's (2016, para 436.2) view that historical data "*are useful indicators of a prevailing TAMRP*", claims to find the statement ambiguous, speculates that the Commission meant that the Ibbotson approach produces reliable estimates of the prevailing TAMRP, and then proceeds to critique that view. However, in the paragraph immediately preceding the quoted words, the Commerce Commission (2016b, para 436.1) recognises that all estimators are imperfect and therefore placing weight on a wide range of estimators is sensible. So, Frontier have not interpreted the Commission's words appropriately and therefore their critique of the interpretation placed upon them is misguided.

Frontier Economics (2016b, section 4.3) notes that the Commerce Commission (2016b, para 435) cites TAMRP estimates from major investment banks in New Zealand, and describes them as a "*limited sample of analysts*". This is not correct. The Commission's sample does not constitute analysts but firms, who each employ many analysts, and each firm's estimate would presumably represent the views of the majority of its senior analysts. Thus, the number of analysts contributing to the estimates cited by the Commission is much larger than the number of firms and the average 'quality' of these analysts is likely to be well above average.

Frontier Economics (2016b, section 4.3) notes that some Australian analysts conducting independent valuation reports since 2011 have adopted risk-free rates in excess of the prevailing ten-year CGS rate, interprets this uplift as a defacto increment to their MRP estimate, and then suggests that the effective TAMRP estimates of New Zealand analysts might also above their reported values. This is the same issue raised earlier by CEG (2016, section 4.2.2), and addressed in Lally (2016c, pp. 9-10). In particular, Lally (2016c, pp. 9-10) argues that analysts engaged in valuing businesses (with infinite-life cash flows) are therefore

[3] If the methods are ranked from highest outcome (first) to lowest outcome (fifth), Frontier has excluded the fourth and fifth methods. The probability of doing so by chance is the probability of selecting either the fourth or fifth method in the first 'draw' (40%) multiplied by the probability of selecting the remaining one on the second 'draw' (25%), yielding 10%.

interested in the prevailing term structure of risk-free rates for terms out to infinity.[4] Furthermore, typical practice amongst valuers of companies is to use a single risk-free rate, which must then average over the term structure. Since the term structure is currently markedly upward sloping, the average rate invoked by the valuers over the entire term structure would have to be in excess of the ten-year rate. This is consistent with Frontier's (2016b, section 4.3) observation about Australian analysts. It is also consistent with the Fernandez et al (2015) survey to which CEG (2016, section 4.2.2) refers, in that the average risk-free rate used by US respondents in the Fernandez et al (2015, Table 8) survey is 2.4% whilst the prevailing 10, 20, and 30 year US Treasury Bond yields at the time of the survey (March-April 2015) were 2.0%, 2.4%, and 2.6% respectively.[5] Thus, the average risk-free rate used by US respondents corresponds to the prevailing 20-year rate. Accordingly, the MRP estimates of these respondents could be interpreted to be that for a 20-year term, and this raises the question of whether any adjustment is required to provide an estimate for a ten-year term. CEG (2016, section 4.4) considers that an offsetting increase should be made to the TAMRP. Clearly, if a respondent's cost of equity at a given point in time were the same for all future terms (i.e., a flat term structure), then variations in risk-free rates over the term structure would imply perfectly offsetting variations in the MRP over the term structure, in line with CEG's recommendation. However, it is not plausible that the term structure for the MRP would be related to that of the risk-free rate in this way, because the MRP is an allowance for risk and the risk-free rate is the time value of money. Thus, the fact that analysts engaged in valuing businesses use risk-free rates in excess of prevailing ten-year rates does not warrant any adjustment to the MRP estimates provided by them.

Frontier Economics (2016b, section 4.4) notes the Commerce Commission's (2016b, para 436.3) claim that its approach produces stable estimates of the TAMRP that are advantageous for consumers and investors, and then argues that such stable estimates of the TAMRP, in conjunction with highly volatile risk-free rates, maximises the volatility in estimates of the cost of equity, and that this is undesirable to both consumers and investors. However, customers prefer stable prices and this may or may not imply stable estimates of the cost of equity. Furthermore, even if the preference of customers for stable prices did lead to a

[4] Brotherson et al (2013) survey a range of practitioners in the US, where government bonds with maturities up to 30 years exist, and enquired into the risk free rates used for DCF purposes. The shortest maturity bonds used were ten-year bonds and many practitioners used 30-year bonds (ibid, Table 2).

[5] Data from the Federal Reserve Bank of St Louis constant-maturity series (https://research.stlouisfed.org/fred2).

preference for stable estimates of the cost of equity, this could not justify regulators varying their TAMRP estimate to offset changes in the risk-free rate regardless of whether such changes produced better estimates of the TAMRP; estimates of the TAMRP should be chosen to minimise estimation error rather than to smooth out changes in the risk-free rate. Turning next to investors, they do not seek stable estimates of the cost of equity but estimates of the cost of equity that minimise estimation error. Since the risk-free rate is observable, this implies estimates of the TAMRP that minimise estimation error in the TAMRP and my estimates of the TAMRP are chosen in accordance with this principle.

On this question of choosing an estimate of the TAMRP to minimise the estimation error, Frontier (2016b, page 44) does refer non-specifically to Frontier (2016a), and Frontier (2016a, section 2.6.4) argues that the DGM is most likely to reflect prevailing market conditions (because it is entirely forward-looking), that it has also produced plausible estimates of the MRP in Australia, and therefore should be given primary weight in New Zealand. However, as argued by Lally (2016c, pp. 18-19), the 'best' estimator of the TAMRP has minimum mean squared error (MSE), the DGM is likely to be biased when assuming (as is generally done) that the cost of equity is the same for all future years, and even if it were not many alternative estimators have low correlation with the DGM and low correlation would support significant weight on these alternatives even if they are biased. These arguments support an estimate of the TAMRP that applies weight to several different methods as in Lally (2015a, section 7), and this in turn leads to a relatively stable estimate of the TAMRP. Such an approach is likely to produce an estimate of the TAMRP that is too low under some conditions and too high under others, but it will still have the lowest MSE. Frontier (2016b) does not respond to these arguments.

Frontier Economics (2016b, Appendix) responds to earlier comments from Lally (2016c, pp. 14-17) on the merits of the Siegel version 1 estimator, which were in turn a response to earlier comments in Frontier (2016a, section 2.6.3). These points are as follows. Firstly, Frontier (2016b, page 57) quotes from Lally (2016c, page 14): "*Frontier argues that Siegel (2011) has abandoned his earlier belief about unanticipated inflation in the late 20th century (that it reduced real yields on conventional government bonds, that this induced an overestimate of the MRP, and that this will not persist into the future)...*". Frontier (2016b, page 57) then denies claiming that Siegel abandoned his earlier belief. However, Frontier (2016a, page 24) states that: "*In an article in the wake of the GFC, Siegel (2011, p. 144)*

admits that his prediction that real government bond yields would increase was wrong, as was his assessment that post-war realised bond yields were biased down." In my view, this is a clear statement from Frontier asserting that Siegel has abandoned his earlier view that unanticipated inflation in the late 20th century reduced real yields on conventional government bonds. In any event, the more important point is not what Siegel believes, or what Frontier thinks Siegel believes, but instead what Frontier currently believes, and Frontier's (2016b, page 57) current belief is that "*there is no longer any reason to think that real yields on government bonds over most of the 20th century were too low and require any form of upward adjustment*." However, Frontier (2016b, pp. 57-58) then devotes the entire next page to discussing the causes of what it refers to as the "*relatively low real yields on bonds through much of the 20th century*", thereby contradicting their claim that the real yields were not too low.

Secondly, Frontier Economics (2016b, pp. 57-59) disputes the contention that the low real yields on bonds in the late 20th century were due exclusively to unanticipated inflation and offers a number of alternative explanations including the legacy of fear from the Great Depression, interest rate controls from WWII till the 1980s, redistributive government policies after the Great Depression, and increased liquidity in the market for government bonds. However I have never asserted that the low real bond yields in the late 20th century were due exclusively to unanticipated inflation. Furthermore, the list of alternative explanations appears earlier in Frontier (2016a, section 2.6.3), to which a response appears in Lally (2016c, page 15): the last two phenomena could not have given rise to the negative real yields on bonds during the late 20th century (they could only have added to the effect of unanticipated inflation), and the first two phenomena were (like unanticipated inflation) temporary and therefore reinforce the conclusion that low real yields on bonds in the late 20th century were temporary, leading to an upward but temporary effect on the estimated MRP, thereby justifying a downward adjustment to the Ibbotson estimate. Frontier's (2016b, page 58) only response is to argue that my reference to the late 20th century does not include the post-war years in which these phenomena operated. This is not correct; my reference to the late 20th century is to the years 1946-2000, which includes the post-war years however defined.

Further information on the question of whether unanticipated inflation was the dominant factor in low real yields in New Zealand in the late 20th century is available from Lally and

Marsden (2004b, Table 2), who provide the average inflation rate and real bond yields in New Zealand over the set of five year periods from 1946-2000. Across these 11 five-year periods, inflation exceeds that in the preceding period on five occasions and these are the *same* five occasions in which the real yields on bonds are negative. None of the alternative explanations offered by Frontier could explain such a perfect match. Furthermore, the mechanism through which unexpectedly higher inflation gives rise to negative real yields on nominal bonds is clear: the nominal yields are set in accordance with expected inflation, and inflation in excess of that expectation therefore depresses the real yield. Consequently, this perfect match in the data presented by Lally and Marsden (2004, Table 2) strongly supports the proposition that unanticipated inflation was the dominant explanation for low real yields on bonds in New Zealand over the late 20th century.

Thirdly, Frontier Economics (2016b, pp. 60-61) argues that unanticipated inflation is only one of a number of events that investors failed to anticipate and correcting for it without also correcting for other such phenomena leads to a one-sided adjustment. Again this argument has been presented earlier in Frontier (2016a, section 2.6.3), to which a response appears in Lally (2016c, page 15): the impact of unanticipated inflation is one of a large set of phenomena giving rise to overestimation of the MRP from the Ibbotson methodology, no phenomena operating in the opposite direction are apparent, the downward adjustment to the Ibbotson MRP to reflect only unanticipated inflation is the only one of these phenomena that can be estimated to an acceptable degree of precision, and this supports the case for doing so. Frontier (2016b, pp. 60-61) does not respond to these points.

Fourthly, Frontier (2016a, section 2.6.3) argues that implementation of the Siegel 1 estimator of the TAMRP requires a reliable estimator of the expected real rate of return on nominal government bonds (averaged over the relevant historical period), these inflation-protected bonds have lower liquidity than nominal government bonds, this raises their real yield, and therefore the real yield on such bonds would overestimate the expected real yield on nominal bonds. In response, Lally (2016c, page 8) acknowledges that the inferior liquidity of inflation-indexed bonds raises their real yields but adds that the real yield on nominal bonds is uncertain (because inflation is uncertain), the same does not apply to inflation-protected bonds, and therefore use of the yield on the latter to estimate the expected real rate on nominal bonds may underestimate the expected real yield on nominal bonds. Since the net effect of these forces is unclear, one cannot conclude that the use of real yields on inflation-

protected bonds would bias the estimate of the average expected real-risk-free rate over the 1931-2014 period. In response, Frontier (2016b, pp. 61-62) states that no evidence was presented by Lally (2016c, page 8) on the impact of inflation risk on the yields on nominal bonds. This is correct, and is now addressed. The empirical work on this issue typically estimates the net effect of these two forces, and recent surveys of the literature conclude that the net effect is unclear. For example, Grishchenko and Huang (2012, page 6) conclude that "..there appears no consensus so far in the (empirical) literature as to not only the magnitude of the inflation risk premium but also its sign."[6] This conclusion is consistent with the comments in Lally (2016c, page 8).

Fifthly, Frontier (2016b, pp. 62-63) notes that Lally (2015a, section 7.3) estimates the expected real rate of return on nominal government bonds (averaged over the period 1931-2014) from the real yield on inflation-indexed bonds from 1996-2014 (averaging 3.6%) and the real yield on nominal bonds over the 1961-1965 period (averaging 2.4%), and critiques this approach for utilising only 23 years of data to draw conclusions about the average experience over 83 years. However, Frontier also notes that Lally and Marsden (2004b) consider a different approach using most of the data and yielding an estimate of 2.3%; this deals with Frontier's concern about the use of only a limited number of years.

Sixthly, Frontier (2016b, page 63) argues that the range in estimates for the expected real yield on nominal government bonds (averaged over the period 1931-2014) from 2.3% to 3.6% as described in the previous paragraph reveals that this parameter cannot be reliably estimated, and therefore that the Siegel 1 approach should not be used. However, for any estimate of this parameter within this range from 2.3% to 3.6%, the Siegel 1 estimate of the TAMRP is the lowest of the estimates in Lally (2015a, Table 4). In particular, with an estimate for this parameter of 2.3% rather than the 3.5% estimate actually used in Lally (2015, section 7.3), the resulting Siegel 1 estimate of the TAMRP would rise from 5.9% to 6.8%, still leaving it lowest amongst the estimates using New Zealand data, and therefore would not affect the median estimate of 7.1%. Thus, for the purposes here, the expected real rate of return on nominal government bonds (averaged over the period 1931-2014) can be estimated sufficiently reliably.

[6] The words "inflation risk premium" as used by these authors refers to the net effect of these two phenomena.

5. RAB Indexation

Vector (2016, para 33) argues that the Commission's practice of reducing allowed revenues in accordance with forecast inflation whilst rolling forward the RAB in accordance with actual inflation leads to "back loading" of businesses' revenues. This claim is not correct; it is the Commission's recourse to indexation rather than the use of both expected and actual inflation that leads to "back loading" of businesses' revenues. Furthermore, the back loading is in nominal terms but not in real terms. So, the issue here is whether revenues should be constant in real or nominal terms. Obviously, businesses would prefer cash flows to be constant in nominal terms, and hence front-loaded in real terms, because it reduces their exposure to stranding risk. However, the result is that revenues are front-loaded in real terms and this leads to today's consumers bearing a larger burden relative to their incomes than the next generation. This is an inter-generational inequity.

Vector (2016, paras 35-50) favours inflation adjustments using the expected inflation rate throughout the process rather than a mix of forecast and actual inflation. This has three advantages: it removes the bankruptcy risk to businesses arising from actual inflation being less than forecast inflation, it eliminates any violations of the NPV = 0 principle due to regulators' errors in estimating expected inflation, and it reduces the effort that needs to be devoted to correctly estimating the expected inflation rate because errors in doing so no longer induce violations of the NPV = 0 principle. The only drawback is that the RAB will evolve over time in accordance with expected inflation rather than actual inflation. Thus the real expenditures by consumers will be affected by inflation shocks. For example, if the regulatory cycle is one year, expected inflation over the next year is correctly estimated at 2.5% but actual inflation is 0%, the allowed revenues over the next year will be reduced by 2.5% whilst the RAB at year end will rise in compensation by 2.5%, leading to all subsequent nominal (and hence real) revenues rising by 2.5%. However, such errors apply to only a single regulatory cycle and will tend to net out over a succession of regulatory cycles. The same is true of the bankruptcy risks and violations of the NPV = 0 principle arising from errors in estimating the expected inflation rate. So, the advantages and disadvantages are both small but the advantages outweigh the disadvantages. I therefore favour the proposal.

Transpower (2016a, section 4.2) opposes the Commerce Commission's (2016a, paras 233-236) proposal to deal with inflation risk for Transpower (which is not currently subject to

RAB indexation), by adjusting revenues by the difference between actual and expected inflation applied to the RAB, on various grounds. Firstly, Transpower argues that its cost of debt is set in nominal terms and therefore cannot be adjusted ex-post for differences between actual and expected inflation. This claim is correct and there are also effects upon shareholders. The full situation is thus. Under the present regime for Transpower, inflation that is larger (smaller) than expected reduces (enlarges) the real cash flows received by capital suppliers in aggregate and both debtholders and shareholders are affected in the same direction. By contrast, under the proposed regime, the adjustment protects the real cash flows to capital suppliers in aggregate from inflation shocks but, since payments to debtholders are fixed in nominal terms, debtholders benefit (suffer) ex-post from lower (higher) than expected inflation and shareholders would therefore be placed in the opposite situation (benefiting if inflation is higher than expected and suffering if inflation is lower than expected).

For example, suppose Transpower's leverage is 40%, the nominal cost of equity is 8%, the nominal cost of debt is 6% and expected inflation over the next regulatory cycle (five years) is 2%. Shareholders then expect a real cost of equity of 6% per year over this period and debtholders expect 4%. Under the present regime, if inflation is instead 1% (3%), the real return on equity becomes 7% (5%) per year and the real return on debt becomes 5% (3%) per year assuming no other shocks. By contrast, under the Commission's proposal, if inflation is 1% (3%), the real return on debt is still 5% (3%) per year as before but revenues are now retrospectively lowered (raised) by 1% of the RAB per year and hence 1.67% of the equity value per year, yielding a nominal return to equity of 6.33% (9.67%) per year, and therefore a real rate of return of 5.33% (6.67%) per year assuming no other shocks. These results are summarised in Table 1.

Table 1: The effect of Inflation Shocks on Transpower's Debtholders and Equityholders

	Current Regime		Proposed Regime	
	i = 1%	i = 3%	i = 1%	i = 3%
Equity Nominal ROR	8%	8%	6.33%	9.67%
Equity Real ROR	7%	5%	5.33%	6.67%

Debt Nominal ROR	6%	6%	6%	6%
Debt Real ROR	5%	3%	5%	3%

So, the Commission's proposal would not affect the inflation risks faced by debtholders and only mildly reduce the inflation risks faced by shareholders. This undercuts the rationale for the Commission's proposal. One possible response to this point is that businesses could switch to indexed bonds, in which case the rationale for the Commission's proposal is preserved, but this may not be feasible. Another possible response is for the Commission to adjust only the equity component of the RAB for inflation shocks, which also preserves the Commission's rationale.

Secondly, Transpower argues that the expected rate of inflation is unobservable and therefore any estimate of it will be unreliable. However, the crucial issue in any forecast is whether the average of the forecasts matches the average of the realised outcomes; if a forecast has this property, any errors will tend to offset over time. Furthermore, the forecast used by the Commission is a mix of the Reserve Bank's forecasts and the midpoint of the Reserve Bank's inflation target (2%), and the average inflation rate since this inflation target was adopted in September 2002 has been 2.1%.[7] Thus, the inflation target appears to have the essential feature, and modifications to that forecast from use of the Reserve Bank's forecasts could be expected to improve it rather than undercut it.

Thirdly, Transpower argues that the WACC set by the Commission at the commencement of a cycle is the same for each year, this reflects the market's average inflation expectation over that period, this average will not be relevant to each individual year, and this will either complicate or invalidate the Commission's proposed ex-post revenue adjustment. However, Transpower do not explain how the features described above complicate or invalidate the proposed adjustment, and I fail to perceive any such difficulties.

The ENA (2016a, section 4) argues that the Reserve Bank's inflation forecasts (which the Commission in part relies upon) have been biased upwards over the period since the Input Methodologies have applied, and cites evidence from Lees (2016, Figure 8) in support of this.

[7] Table M1 on the Reserve Bank's website reports the CPI at September 2002 and June 2016 at 904 and 1205 respectively, implying an average inflation rate of 2.1% per year.

However, Lees (2016, page 8) notes that the period examined by him (2009-2015) is not only unusually short but too short to even test the results for statistical significance. A better test is over the complete period since the 1% - 3% inflation target was adopted in September 2002, and reveals that even the midpoint of the inflation target (the cruder component in the Commission's inflation forecast) was only marginally biased (i.e., only marginally different to the average realised outcome of 2.1%, as noted above).

The ENA (2016a, section 4) proposes a number of alternative approaches to the present regime for EDBs, comprising no inflation adjustments, revaluing the RAB in accordance with forecast rather than actual inflation, and a wash-up for the difference between forecast and actual inflation within the price-quality path. The eschewing of inflation adjustments implies that revenues will fall in real terms and therefore impose an inequitable burden upon the current users of the assets relative to later generations. Of the two other possibilities described above, the more important issue is the mechanics of RAB indexation, and the ENA's proposal corresponds to that of Vector discussed above. As discussed there, I favour the proposal.

Orion (2016, page 19) opposes indexation of the RAB for inflation on the grounds that it pushes cost recovery for businesses further into the future and therefore raises stranding risk. However, the consequence of not indexing for inflation is to load costs unduly upon current consumers relative to later generations. So, there is a trade-off for a regulator, but this requires decisions tailored to the specific circumstances of businesses rather than a general rejection of indexation. Consistent with this tailored approach, the Commission adopts indexing for EDBs but not for Transpower.

My principal views on indexation are now summarised, as follows. Firstly, in respect of the NPV = 0 principle, all approaches under discussion satisfy this requirement, subject to the use of both the expected inflation rate the actual rate exposing the regulator to errors in correctly estimating the expected rate of inflation (as with the present regime for most regulated businesses and the proposed regime for Transpower). Even in this case, the errors apply to only a single regulatory cycle and therefore would tend to offset over successive regulatory cycles. Secondly, in respect of consumers, indexation of the RAB at the actual inflation rate maintains the real revenues over time, and therefore better allocates costs across successive generations of consumers than from not indexing (which leads to real revenues

declining over time), whilst indexing the RAB using the expected inflation rate is almost as good. Thirdly, bankruptcy risks arise when indexing the RAB using the actual inflation rate whilst reducing revenues in accordance with the expected inflation rate, but these risks are slight within a single regulatory cycle, and the set of uncorrelated errors over successive regulatory cycles would tend to offset. Fourthly, using the expected inflation rate for the revenue deduction and the actual rate for the RAB indexation protects the revenues of businesses against inflation shocks but the general practice for firms to borrow at nominal interest rates implies that neither shareholders nor debtholders are protected against such shocks. Fifthly, the need to accurately estimate the expected inflation rate is greatest when using the expected inflation rate for the revenue deduction and the actual rate for the RAB indexation. These points suggest that the best course of action is to index (so as to better allocate costs over time to consumers) unless there are strong concerns about stranding risk, and to use the expected inflation rate throughout the process so as to eliminate deviations from NPV = 0 and hence also minimise the effort required to accurately estimate the expected rate of inflation.

6. The Cost of Debt: Trailing Average versus Rate on the Day

Frontier Economics (2016b, section 2.2) notes that the transactions costs of interest rate swaps are not incurred under the trailing average cost of debt (TACD) approach, these savings could be passed through to consumers, and this as an argument in support of the TACD over the existing rate on the day (ROTD) approach. However, since the base rate used under the TACD would be in excess of five years (and Frontier favours ten years), and the regulatory base rate that is appropriate under the ROTD approach would be five years because firms could hedge it using interest rate swaps, and the five year base rate is typically below the ten-year base rate, this interest rate saving must be offset against the transactions costs of the swaps. So, it does not follow that the TACD approach will lead to lower costs. Furthermore, Lally (2016b, pp. 23-26) shows that the expected saving in interest costs would be well in excess of the transactions costs of the swaps. Frontier (2016b, footnote 12) is clearly aware of the latter paper but does not refer to these expected savings in interest costs, and can therefore be presumed to be accepting the point.

Frontier Economics (2016b, sections 2.2.1, 2.2.2) argues the ROTD approach leads to large mismatches between the allowed and incurred costs of debt. For example, Frontier (2016b,

Figure 5) shows deviations as large as 7%. However, these comparisons are between the cost of debt at a particular point in time and the average over an eleven year period from some period before the particular point in time and some period after it. By contrast, the appropriate comparison is between the allowed cost of debt prevailing at a particular point in time *T* (which will have been set at the beginning of the regulatory cycle in which that particular point in time lies) and the trailing average prevailing at the same point in time *T*. Furthermore, the importance of these differences lies not in their absolute level but in relation to the regulatory allowance for the cost of equity, because the latter is a cushion that can potentially absorb the DRP mismatch. Furthermore, the comparison should invoke New Zealand data. Frontier's analysis lacks the first two of these essential features, and most of it also lacks the third feature. By contrast, Lally (2014, Appendix 1) conducts an analysis of this type using New Zealand data and concludes that the possible mismatches do not exceed 2.5% of the cost of equity cushion. This is inconsequential. Frontier does not respond to it.

Frontier Economics (2016b, section 2.2.3) refers to the possibility of a natural hedge between DRP mismatches under the ROTD method and errors in estimating the TAMRP, which was raised in Lally (2015c, pp. 11-13), and challenges the Commission to quantify the TAMRP errors so as to demonstrate that there is a natural hedge. However, as Frontier is well aware, the TAMRP cannot be observed and therefore such an exercise could not be carried out. The important issue is whether it is plausible that the true but unobservable TAMRP is positively correlated with the DRP net of its ten-year trailing average, i.e., both tend to be high during a crisis and low in good economic conditions. Frontier does not dispute the plausibility of this scenario. Frontier also argues that the need for a hedge is removed by simply estimating the TAMRP commensurate with prevailing market conditions, and refers to Frontier (2016a) in support of this. Frontier (2016a, section 2.6.4) argues that the DGM is most likely to reflect prevailing market conditions (because it is entirely forward-looking), that it has also produced plausible estimates of the MRP in Australia, and therefore should be given primary weight in New Zealand. However, Frontier (2016b, section 4.1) now proposes to place weight on three different methods (Ibbotson, Siegel 2, and the DGM), of which the first reflects average market conditions over a long historical period and the second partially does so. These latest views contradict Frontier's claim that the TAMRP should be estimated commensurate with prevailing market conditions and therefore there is no need for a hedge.

Frontier Economics (2016b, section 2.3) refers to the TACD approach reducing volatility in prices (which is common ground), and critiques two mitigating factors discussed by the Commerce Commission (2016a, para 122). The first of these concerns the use of swap contracts, which the Commission considers would reduce volatility in prices. Frontier's response is that the swap contracts have no effect on prices and merely serve to hedge the risk-free rate costs incurred by businesses to the rate allowed under the ROTD approach. I agree with Frontier on this point. The second of Frontier's points concerns the Commission's ability to smooth price changes, to which Frontier responds by claiming that this would increase regulatory uncertainty. Assuming (reasonably) that any smoothing would be done in such a way as to satisfy the NPV = 0 principle, I do not think that Frontier's point is valid.

Frontier Economics (2016b, sections 3.1, 3.2) argues that the TACD approach satisfies the NPV = 0 principle whilst the ROTD approach does not, but does not supply any quantitative analysis in support of these claims. By contrast, Lally (2016b, Appendix) analyses this issue and concludes that both approaches violate the NPV = 0 principle but that the violations are more severe from use of the TACD approach. Frontier (2016b, footnote 12) is clearly aware of the latter paper but does not refer to this analysis here.[8] Frontier (2016b, pp. 22-23) does refer to the matching of debt costs incurred with those allowed under a TACD, over the life of an investment project, but fails to address the problem arising during the first few years of a project if the cost of debt prevailing at the commencement of an investment differs from the trailing average at that point. For example, if the prevailing rate is 7% and the trailing average is 5%, the firm will initially pay 7% whilst receiving only 5%, and this will cause the NPV = 0 principle to be violated.

Frontier Economics (2016b, section 3.4) refers to transitional issues for swap contracts when switching from the ROTD to the TACD approach, and asserts that "*swaps entered into in order to match the ROTD allowance would expire naturally at the end of the regulatory period*" and therefore "*the supplier would enter the next regulatory period with no hedge book.*" However, this is not correct. In order to hedge the base rate risk under a ROTD allowance, a business must swap fixed to floating at the time of borrowing for a term equal to that of the borrowing (type 1 swaps), and additionally swap floating to fixed at the beginning of each regulatory cycle for a term equal to the regulatory cycle (type 2 swaps). So, in the

[8] In a subsequent paper, Frontier (2016c) does address the analysis in Lally (2016b, Appendix) and this paper is discussed below.

event of a regulator switching from the ROTD to the TACD method at the end of a regulatory cycle, the existing type 2 swaps would naturally expire at that time, and therefore would not present any transitional issues, as claimed by Frontier but the type 1 swaps would still be in force at the time of switching from the ROTD to the TACD method, and therefore would require transitional steps.

Frontier Economics (2016b, section 3.4) also refers to transitional issues relating to the DRP when switching from the ROTD to the TACD approach, notes arguments from the AER that switching regimes without transitional arrangements could lock in windfall gains to regulated businesses, but argues that the alleged windfall gains in Australia would not arise in New Zealand because the earliest price-setting decisions made by the Commission were in 2011, by which time the effect of the GFC on prevailing DRPs had dissipated. However, the dissipation claim is contradicted by the decline in the DRP from 2012 to 2016 as shown in Frontier Economics (2016b, Figure 1) and is referred to by Frontier (2016b, page 8) as a "*material variability*". Furthermore, the question of whether a business subject to a regime change in (say) 2016 would experience a windfall gain or loss would depend upon the DRP values for several earlier years as a result of the firm paying a trailing average. Lally (2015b, Table 1) provides results using Australian data, and this shows that regime switches even at a time at which the DRP had stabilised following the GFC shock could give rise to substantial windfall gains if there were no transitional arrangements.

Frontier Economics (2016b, section 3.4) claims that the TACD approach is the only one that is consistent with the NPV = 0 principle. However, Frontier supplies no analysis in support of this claim. By contrast, Lally (2016b, Appendix) analyses this issue and concludes that the TACD approach does violate the NPV = 0 principle. Frontier (2016b, footnote 12) is clearly aware of the latter paper but does not refer to this analysis here.[9]

Frontier Economics (2016b, section 3.4) also claims that the ROTD approach violates the NPV = 0 principle, because the allowed rate is fixed at the beginning of the regulatory cycle during which the debt is issued rather than when the debt is issued. This is correct. However, as shown in Lally (2016b, Appendix), the violations of the NPV = 0 principle are more

[9] In a subsequent paper, Frontier (2016c) does address the analysis in Lally (2016b, Appendix) and this paper is discussed below.

severe under the TACD approach. Frontier (2016b, footnote 12) is clearly aware of the latter paper but does not refer to this analysis here.[10]

Transpower (2016a, section 3) argues that the ROTD approach will not satisfy the NPV = 0 principle if the DRP mismatches under the ROTD method do not offset over time.[11] However, the NPV = 0 principle is concerned with expectations over future outcomes rather than the actual outcomes that arise. Thus, if the DRP mismatches are expected to be zero in the mathematical sense, the fact that mismatches will and do occur (some positive and some negative) would not cause a violation of the NPV = 0 principle. By analogy, if a fair coin is tossed 50 times (with +1 for a head and -1 for a tail), the actual average outcome will be unlikely to be zero but the expectation of that outcome is zero. Transpower has confused the expectation with the actual outcome.

Transpower (2016a, section 3) argues that the TACD approach will likely satisfy the NPV = 0 principle because there will be a close alignment between the DRP costs allowed by the regulator and those incurred by an efficient firm. However, a firm that undertakes new investment immediately incurs the prevailing cost of debt whilst the regulatory allowance under the TACD approach would be a trailing average, and several years must elapse before these match. The resulting mismatches in this initial phase cause violations of the NPV = 0 principle. The ROTC approach also faces mismatches in the initial years that induce violations of the NPV = 0 principle. These matters are analysed in Lally (2016b, Appendix), and reveal that the violations of the NPV = 0 principle are more severe under the TACD approach than the ROTD approach. Clearly, Transpower (2016a, footnote 10) is aware of the latter paper but does not refer to this analysis here.[12]

Transpower (2016a, section 3) argues that the DRP mismatches arising under the ROTD approach will "discourage efficient investment". However, Lally (2014, Appendix 1) conducts an analysis of this issue using New Zealand data and concludes that the possible

[10] In a subsequent paper, Frontier (2016c) does address the analysis in Lally (2016b, Appendix) and this paper is discussed below.

[11] Transpower refers to mismatches in the cost of debt rather than merely the DRP. However, mismatches in the base rate component under the ROTD method are eliminated by the use of interest rate swap contracts, and therefore the only source of mismatches lies in the DRP.

[12] In a subsequent paper, Frontier (2016b) does address the analysis in Lally (2016b, Appendix) and this paper is discussed below.

mismatches do not exceed 2.5% of the cost of equity cushion. This is inconsequential. Transpower does not comment on this report.

Transpower (2016a, section 3) refers to lower price volatility from the TACD approach compared to the ROTD approach, which supports use of the TACD approach, and describes contrary arguments as "*mainly academic, outdated and unsupported by evidence*". However, one of these contrary arguments is the lesser violations of the NPV = 0 principle arising from use of the ROTD approach, as demonstrated in Lally (2016b, Appendix). Transpower has not commented on that analysis here.[13] Another is that the DRP mismatches under the ROTD approach are trivial in relation to the cost of equity cushion, as shown in Lally (2014, Appendix 1). Again, Transpower has not commented on that analysis.

Transpower (2016a, section 3) notes that the transactions costs of interest rate swaps are not incurred under the trailing average cost of debt (TACD) approach, these savings could be passed through to consumers, and this as an argument in support of the TACD. The same argument has been raised by Frontier (2016b, section 2.2) and addressed at the beginning of this section. Briefly, since the base rate used under the TACD would be in excess of five years (and Frontier favours ten years), and the regulatory base rate that is appropriate under the rate on the day (ROTD) approach would be five years because firms could hedge it using interest rate swaps, and the five year base rate is typically below the ten-year base rate, this interest rate saving must be offset against the transactions costs of the swaps and the expected interest rate savings are well in excess of the transactions costs of the swaps.

Transpower (2016a, section 3) argues that the New Zealand swap market could not easily accommodate the volume implied by the ROTD method, and widening the transaction window from one to three months would only slightly alleviate it. However, Transpower presents no evidence for these claims. Furthermore, if firms conduct their transactions over the same period used by the regulator to estimate the prevailing cost of debt, tripling the length of the window would reduce the additional transactions per month by 67% and such a reduction could not reasonably be described as a slight alleviation. Furthermore, regardless of the period used by the regulator to set the allowed cost of debt, firms would be free to spread their transactions over a wider period; Lally (2015b, Appendix 2) examines the effect

[13] In a subsequent paper, Frontier (2016b) does address the analysis in Lally (2016b, Appendix) and this paper is discussed below.

of a firm using a period of five months rather than one month for transacting the swaps (corresponding to the longest period argued for in submissions for addressing the problem) in conjunction with a one month window used by the regulator for setting the allowance under the ROTD method, and finds that this has no material impact on the mismatches.

Wellington Electricity (2016, page 4) argues that the TACD approach should be adopted by the Commission because it accords with the actual debt management practice of businesses. However, a firm that undertakes new investment immediately incurs the prevailing cost of debt whilst the regulatory allowance under the TACD approach would be a trailing average, and several years would elapse before these match. Thus the TACD will not match the actual debt practices of firms in this situation. This point is discussed in Lally (2016b, Appendix). Wellington Electricity does not refer to this paper.

Wellington Electricity (2016, page 4) asserts that the transactions costs of interest rate swap contracts can be significant, and may exceed the expected saving in interest costs in firms effectively borrowing for five years rather than ten years. However, Wellington Electricity offers no evidence on these matters. By contrast, Lally (2016b, pp. 23-26) shows that the expected saving in interest costs would be well in excess of the transactions costs of the swaps. Wellington Electricity does not refer to this paper.

Wellington Electricity (2016, page 5) argues that the TACD approach is compliant with the NPV = 0 principle. However, no proof is provided. By contrast, Lally (2016b, Appendix) reveals that the TACD approach is not compliant with the NPV = 0 principle and the violations of it are more severe under the TACD approach than the ROTD approach. Wellington Electricity does not refer to this paper.

Wellington Electricity (2016, pp. 5-6) argues that widening the period used by the Commission to determine the prevailing cost of debt from one to three months under the ROTD method would only be helpful to regulated businesses if they hedged continuously over that period, that this is not efficient, that they would have to hedge over a shorter period, and this would prevent them from matching their actual cost of debt to that allowed by the Commission. However, Wellington Electricity presents no evidence that hedging over a shorter period than that used by the Commission to set the allowed cost of debt would create any material discrepancy between the costs incurred and those allowed. Furthermore, Lally

(2015b, Appendix 2) examines the effect of a firm using a period of five months rather than one month for transacting the swaps (corresponding to the longest period argued for in submissions for addressing the problem) in conjunction with a one month window used by the regulator for setting the allowance under the ROTD method and finds that this has no material impact on the mismatches. This implies that Wellington Electricity's concern is unwarranted. Wellington Electricity does not refer to this paper.

Wellington Electricity (2016, page 6) argues that widening the period used to determine the prevailing cost of debt from one to three months under the ROTD approach is unlikely to mitigate the problem of a large volume of transactions within the same narrow window. However, Wellington Electricity presents no evidence on this question. Furthermore, as discussed in Lally (2016b, page 8), the longest period argued for in submissions to the AER for addressing the problem is five months and an analysis of the effect of a firm using a period of five months rather than one month in conjunction with a regulator using a one month window for setting the allowance under the ROTD method reveals that this has no material impact on the mismatches. This implies that Wellington Electricity's concern is unwarranted. Wellington Electricity does not refer to this paper.

Wellington Electricity (2016, page 6) notes an argument raised in Lally (2015c, pp. 11-13), that there is a natural hedge between DRP mismatches under the ROTD approach and errors in estimating the TAMRP. In response, Wellington Electricity (2016, page 6) argues that the US data used by Lally (2015c, pp. 11-13) to investigate that question may not be relevant to New Zealand. I acknowledge this point; the US DRP data was used because New Zealand DRP data for a sufficiently long period was not available. Wellington Electricity (2016, page 6) also asserts that the argument raised in Lally is "*circular*", but fails to explain this claim and I do not understand it.

The ENA (2016b, para 84) notes that the transactions costs of interest rate swaps are not incurred under the TACD approach and present this as an argument in support of the TACD method. The same argument has been raised by Frontier (2016b, section 2.2) and addressed at the beginning of this section. Briefly, since the base rate used under the TACD would be in excess of five years (and Frontier favours ten years), and the regulatory base rate that is appropriate under the rate on the day (ROTD) approach would be five years because firms could hedge it using interest rate swaps, and the five year base rate is typically below the ten-

year base rate, this interest rate saving must be offset against the transactions costs of the swaps and the expected interest rate savings are well in excess of the transactions costs of the swaps.

The ENA (2016b, paras 84-85) argues that significant DRP mismatches arise under the ROTD approach, and this is a significant disadvantage of this approach. However, Lally (2014, Appendix 1) conducts an analysis of this issue using New Zealand data and concludes that the possible mismatches do not exceed 2.5% of the cost of equity cushion. This is inconsequential. The ENA do not comment on this analysis.

The ENA (2016b, paras 86-92) refers to an argument in support of the ROTD approach that has been referred to by the Commission, involving the possibility of a natural hedge between DRP mismatches under the ROTD method and errors in estimating the TAMRP, and challenges the Commission to quantify the TAMRP errors so as to demonstrate that there is a natural hedge. However, the TAMRP cannot be observed and therefore such an exercise could not be carried out. The important issue is whether it is plausible that the true but unobservable TAMRP is positively correlated with the DRP relative to its ten-year trailing average, i.e., both tend to be high during a crisis and low in good economic conditions. The ENA disputes the plausibility of this scenario, and suggests instead that there might be positive correlation between the true but unobservable TAMRP and the DRP relative to the historical average over the past 100 years. However, the ENA presents no evidence on this question. By contrast, Lally (2015c, pp. 11-13) notes that, in the US data series used by him, the highest margins for the prevailing DRP over its ten-year trailing average occur in 2008-09 (3.54%), 1974-75 (1.85%), 2001-2002 (1.71%), 1970-71 (1.67%), and 1980-81 (1.18%); these periods correspond to the set of US recessions since 1970.

The ENA (2016b, para 87) also argues that this natural hedge for errors in estimating the TAMRP evaporates if the TAMRP is estimated commensurate with prevailing market conditions, and recommends that the DGM approach is most likely to do so. However, as argued by Lally (2016c, pp. 18-19), the 'best' estimator of the TAMRP has minimum mean squared error (MSE), the DGM is likely to be biased when assuming (as is generally done) that the cost of equity is the same for all future years, and even if it were not many alternative estimators have low correlation with the DGM and low correlation would support significant weight on these alternatives even if they are biased. These arguments support an estimate of

the TAMRP that applies weight to several different methods as in Lally (2015a, section 7), and this in turn leads to a relatively stable estimate of the TAMRP. Such an approach is likely to produce an estimate of the TAMRP that is too low under some conditions and too high under others, but it will still have the lowest MSE. In this case, the natural hedge arising from use of the ROTD exists.

The ENA (2016b, para 93) refers to a belief by the Commerce Commission (2016a, para 122) that the use of swap contracts would reduce volatility in prices, and argues instead that the swap contracts have no effect on prices and merely serve to hedge the risk-free rate costs incurred by businesses to the rate allowed under the ROTD approach. I agree with the ENA on this point.

PwC (2016, paras 257 – 259) argues that the ROTD approach leads to a concentration of hedging in a predictable period leading to businesses facing opportunistic pricing of these hedging instruments. However, PwC presents no evidence on the extent of this alleged problem. Furthermore, such concerns could be addressed by firms widening the window in which they engaged in these swap contracts even to the extent that this window exceeds that used by the regulator to set the allowed cost of debt. Furthermore, as discussed in Lally (2016b, page 8), the longest period argued for in submissions to the AER for addressing the problem is five months and an analysis of the effect of a firm using a period of five months rather than one month in conjunction with a regulator using a one month window for setting the allowance under the ROTD method reveals that this has no material impact on the mismatches. This implies that PwC's concern is unwarranted.

Contact (2016, section 1.3) notes a number of (alleged) advantages of the TACD approach, and concludes that there are no material drawbacks from it if implemented correctly. However, amongst the advantages listed are better conformity with the NPV = 0 principle, enhancing incentives to invest by eliminating debt mismatches, and elimination of the transactions costs of the swap contracts. Each of these points has been discussed above and are fallacious for the reasons given above.

Contact (2016, section 1.3) also argues that historical data should not be used in implementing the TACD so as to avoid windfall gains to businesses resulting from double-counting of past higher base rate costs. I agree with this point.

Frontier Economics (2016c, section 2.2) argues that the analysis in Lally (2016b, Appendix) is deficient in examining only individual new investments and failing to consider the NPV impact of DRP mismatches in respect of existing investment. For example, if the DRP at the commencement of a regulatory cycle is 3.2% and the contemporaneous trailing average is 1.44% and the ROTD approach is adopted, this DRP discrepancy (subject to expected gradual reversion in the DRP back towards the long-run average) will cause an expected mismatch in respect of existing debt as well as new debt, and the issue is far more significant in respect of existing debt because existing debt is typically much larger. However, Frontier is confusing risk with violations of the NPV = 0 principle. Violations of the NPV = 0 principle can only be assessed at the commencement date of an investment and are based upon expectations about future outcomes formed at that commencement date. By contrast, Frontier's example in relation to existing investments is concerned with an actual outcome (a DRP of 3.2% many years after the investments were made). By analogy, a fair coin (with a head outcome designated 1 and a tail designated -1) has an expected outcome of zero prior to the toss but some outcomes will be heads (1) and others tails (-1). Should a tail occur, it does not contradict the fact that the expected outcome is zero.

Frontier Economics (2016c, section 2.3) argues that the analysis in Lally (2016b, Appendix), which examines violations of the NPV = 0 principle arising from both the ROTD and TACD approaches, is also deficient in examining only DRP mismatches and not also base rate mismatches. However, since Lally's analysis compares NPV = 0 violations from both the ROTD and TACD approaches, Frontier's critique presumes that the TACD would be applied to the entire cost of debt rather than just the DRP and be compared to the results from applying the ROTD to the entire cost of debt. Furthermore, I do not think it would be sensible to apply the TACD to the base rate because the principal argument for using a trailing average is to avoid mismatches between the cost incurred and that allowed under the ROTD, and this argument has only limited relevance to the base rate due to the opportunity to hedge most of the mismatch risk using interest rate swap contracts. So, a comparison of the ROTD with the TACD should be limited to the DRP, as in Lally's analysis.

Frontier Economics (2016c, section 2.3) claims to extend the analysis in Lally (2016b, Appendix) to the entire cost of debt rather than just the DRP and concludes that the violations of the NPV = 0 principle are similar for both the ROTD and TACD methods. However, this

analysis has a number of deficiencies. Firstly, in respect of the ROTD analysis, the base rate analysis is premised upon the single hypothetical scenario described in Frontier (2016c, footnote 10), involving a base risk-free rate of 3% at the commencement of the regulatory period, rising to 5% two years later (at which point the capex occurs), and then remaining at that level. By contrast, Lally (2016b, Appendix) uses an actual data series to determine the values of the DRP at the cycle commencement date, the subsequent date of the capex, and the expected behaviour of the DRP after the investment is undertaken. Hypothetical scenarios can be chosen to demonstrate any result desired, and this scenario may be one of many considered by Frontier but is the only one reported. So, the figure of 1.4% in the first column of Frontier (2016c, Table 2) has no empirical basis. The same applies to the figure of 1.2% in the second column of Frontier (2016c, Table 2).

Secondly, Frontier's hypothetical base rate data described in the previous paragraph is combined with actual DRP data of the same kind used by Lally (2016b, Appendix). So, the two figures in the first column of Frontier (2016c, Table 2) are incompatible. A proper analysis would have to use actual base rate and DRP data from the same country and time period. The same problem afflicts the figures in the second column of Frontier (2016c, Table 2).

Thirdly, in analysing the situation under the TACD approach, Frontier (2016c, para 46) claims to be using the same scenario as for the ROTD analysis. However, the TACD scenario here involves a trailing average base rate of 3% at the commencement of the regulatory period, rising to 5% two years later (at which point the capex occurs), and then remaining at that level. The numbers are the same as in Frontier's earlier analysis but they now relate to the trailing average rather than the prevailing rate. Accordingly, the scenario is quite different. So, the comparison between the ROTD and the TACD applied to the base rate in Frontier (2016c, Table 2) is fallacious because the underlying (hypothetical) data is not the same.

Fourthly, the hypothetical scenario considered in Frontier (2016c, para 46), involving a trailing average base rate of 3% at one point in time (*T*), 5% two years later, and remaining at that level thereafter, would require a sequence of highly implausible prevailing values, and expectations of future values that are even more so. For example, if the actual DRP was 3% for each of the ten years up to time *T*, consistent with the trailing average being 3% at time *T*,

the prevailing values over the next two years would have to be 13% to produce a (ten-year) trailing average of 5% at the end of that two year period, and then immediately drop to 3% for the next eight years in order to sustain the trailing average at 5% over those eight years, and then jump back to 13% in the next year to sustain the trailing average at 5%, etc. Furthermore, once the capex is undertaken, the relevant numbers from that point have to be expectations rather than actual outcomes. So, in Frontier's example, the base rate is 3% at the commencement of the cycle, it leaps to 13% two year later, it is then expected to revert to 3%, to remain at that level for eight years, and is then expected to rise to 13% in the ninth year. Such a scenario is almost inconceivable, and illustrates the need to use actual rather than hypothetical data.

Frontier Economics (2016c, section 3.1) notes that suppliers can hedge risk arising from the ROTD approach (by using swap contracts to match their incurred base rate costs to those allowed by the Commission under the ROTD approach) but that consumers could not hedge their exposure to volatility in prices arising from the ROTD approach. However, the volatility in prices resulting from the ROTD that consumers face from these regulated businesses is a trivial component in their entire expenditures and income. By contrast, the base rate risk to suppliers from the ROTD is much more significant.

Transpower (2016b, pp. 2-3) raises three concerns with the analysis in Lally (2016b, Appendix), which shows that deviations from the NPV = 0 principle are less severe for the ROTD approach rather than the TACD approach. Two of these points (that the Lally analysis ignores the base rate, and that it ignores mismatches in respect of existing investment) are also raised by Frontier (2016c) and discussed above. As argued there, the points raised are invalid. Transpower's third concern is that Lally assumes that all investment that occurs during a cycle is known at the commencement of the cycle and can be hedged. However, the claim is not correct. Lally (2016b, Appendix) makes no such assumption nor could any such assumption be made because Lally's analysis is concerned with only the DRP (which can't be hedged).

Transpower (2016b, Appendix A) argues that the effect of hedging the base rate by regulated businesses in August 2014 (plus the two shoulder months) raised swap cost by 30-50 basis points. However the data presented by Frontier (2016b, Figure 1) in support of this claim contains so much variation that attributing all variation within a particular period to hedging

induced by the ROTD method is unjustified. Transpower also argues that the correlation between the US and New Zealand interest rates was unusually low during this three month period, and attributes this to the increased hedging driven by the ROTD method. However, Transpower's (2016b, Figure 2) graph presented in support of this shows a further period of low correlation outside the ROTD driven hedging period, which undercuts Transpower's hypothesis. Transpower also argues that the normal daily volume for five-year swap contracts is $200m, that the ROTD driven hedging activity would raise this by 50% even if spread over a three month period, and that this additional volume would be likely to affect swap prices. It is uncontroversial that the additional swap transactions would move prices, but I am unable to offer a view on the extent of the movement. However, Lally (2015b, Appendix 2) examines the effect of a firm using a period of five months for transacting the swaps (corresponding to the longest period argued for in submissions to the AER for addressing the problem) in conjunction with a one month window used by the regulator for setting the allowance under the ROTD method, and finds that this has no material impact on the mismatches faced by a business. So, with the three-month window proposed by the Commission, there is considerably more scope for businesses spreading the transactions over time than Transpower assumes here, and therefore considerably more scope for lessening the problem.

7. Conclusions

This paper has reviewed submissions on a range of issues relating to the cost of capital and RAB indexation. I agree with a number of points raised in the submissions but there are only two points at which these submissions might support a change in the Commission's proposed course of action.

The first of these is Vector's proposal for inflation indexation of the RAB to use the expected inflation rate rather than the actual inflation rate. The use of the expected inflation rate has three advantages over use of the actual inflation rate: it removes the bankruptcy risk to businesses arising from actual inflation being less than forecast inflation, it eliminates any violations of the NPV = 0 principle due to regulators' errors in estimating expected inflation, and it reduces the effort that needs to be devoted to correctly estimating the expected inflation rate because errors in doing so no longer induce violations of the NPV = 0 principle. The

only drawback is that the RAB will evolve over time in accordance with expected inflation rather than actual inflation. Thus the real expenditures by consumers will be affected by inflation shocks. However, such errors apply to only a single regulatory cycle and will tend to net out over a succession of regulatory cycles. The same is true of the bankruptcy risks and violations of the NPV = 0 principle arising from errors in estimating the expected inflation rate. So, the advantages and disadvantages are both small but the advantages outweigh the disadvantages. I therefore favour Vector's proposal.

Secondly, and in relation to the Commission's proposal to deal with inflation risk for Transpower (which is not currently subject to RAB indexation) by adjusting revenues by the difference between actual and expected inflation applied to the RAB, Transpower's point that the cost of debt is set in nominal terms and therefore cannot be adjusted ex-post for differences between actual and expected inflation is correct. The consequence of this is that, under Transpower's present regime, inflation that is larger (smaller) than expected reduces (enlarges) the real cash flows received by capital suppliers in aggregate and both debtholders and shareholders are affected in the same direction. So, both face real risk. By contrast, under the proposed regime, the adjustment protects the real cash flows to capital suppliers in aggregate from inflation shocks but, since payments to debtholders are fixed in nominal terms, debtholders benefit (suffer) ex-post from lower (higher) than expected inflation and shareholders would therefore be placed in the opposite situation (benefiting if inflation is higher than expected and suffering if inflation is lower than expected). So, the Commission's proposal would not affect the inflation risks faced by debtholders and only mildly reduce the inflation risks faced by shareholders. This undercuts the rationale for the Commission's proposal. One possible solution would be for firms to borrow using indexed debt (which may not be feasible). Another possible solution would be for the Commission to inflation adjust only the equity component of the RAB.

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