# Evidence on the WACC percentile

A REPORT PREPARED FOR TRANSPOWER IN RESPONSE TO THE COMMERCE COMMISSION CONSULTATION

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# Executive summary

On 31 March 2014, the Commerce Commission ('the Commission') issued a 'notice of intention' to do further work on the cost of capital input methodologies (IMs) that apply to electricity lines services, gas pipeline services and specified airport services regulated under Part 4 of the Commerce Act.

In issuing the notice of intention, the Commission invited interested parties to provide submissions on evidence regarding the appropriate weighted average cost of capital ('WACC') percentile that should be used under the cost of capital IMs. The Commission noted that parties are welcome to respond to points raised in submissions on the Commission's previous round of consultation.

In light of this, we have been asked by Transpower to address three specific issues:

1. NZIER's claim that UK regulators have abandoned the practice of setting allowed rates of return above the midpoint of the WACC range.
2. Possible reasons why the enterprise values of regulated suppliers may exceed the RAB value.
3. If and how a loss function approach could be implemented by the Commission to aid its selection of a point estimate from an estimated WACC range.

We summarise our main findings on each of these issues, and overall conclusions, below.

## *UK regulatory practice in relation to selection of a WACC percentile*

In response to the Commission's first consultation on the WACC percentile issue, NZIER claimed that regulators overseas (in particular, those in the UK) have recently abandoned the practice of setting allowed rates of return above the midpoint on the WACC range. NZIER provided no evidence to support its assertion. NZIER's claim is factually incorrect. There are many, very recent examples of regulators in the UK allowing rates of return well above the midpoint of the WACC range and, in several instances, significantly higher than the 75$^{th}$ percentile. There has been no shift in regulatory practice of the kind claimed by NZIER.

It is also clear that the High Court, in the IMs Merit Appeal decision, was incorrect to conclude that: "Nor is overseas practice suggestive that such an approach has found more than narrow favour, since the only examples from the

numerous regulatory decisions made every year were two relating to United Kingdom airports".[1] The opposite is in fact the case.

We also argue that the apparent tendency for UK regulators to adopt higher WACC percentiles than the Commission cannot be attributed to being tougher than the Commission when estimating individual WACC parameters. We show that had the IM approach been used by UK regulators to estimate key parameters such as the risk-free rate, market risk premium and the cost of debt, UK determinations of those parameters, over the past five years, would have been lower than they in fact have been. All else remaining equal, this would have resulted in lower allowed rates of return than were actually permitted by those regulators. The Commission's IM approach is *less generous* to regulated suppliers than approaches used by UK regulators.

### Possible explanations for enterprise values for regulated suppliers in excess of the RAB

When considering possible empirical evidence on the most suitable WACC percentile in its February 2014 consultation paper, the Commission referred to Northington Partners' observation that the 2013 Powerco transaction implied an enterprise value (EV) well in excess of the business's RAB. Transpower has asked us to comment on the Commission's suggestion that the "the obvious implication of transactions that exhibit a significant premium to the [RAB] value is that investors' behaviour indicates the relevant company's cost of capital is lower than the regulator's assumption". Our view is that there are many alternative, plausible explanations for an EV premium over the RAB; the one posited by the Commission is only one of many. The Commission should resist the urge to jump to the conclusion that excess returns is the "obvious" explanation for any observed premium.

### Implementation of a loss function approach

Finally, we considered if and how a loss function approach could be implemented by the Commission to aid its selection of a point estimate from an estimated WACC range. Dobbs (2011) has provided a clear framework not only for developing an allowed rate of return loss function for regulated suppliers, but also for utilising that function to estimate the optimal allowed rate of return percentile within a range using a Monte Carlo modelling approach.

In our view, a reasonable and pragmatic first step in applying loss function analysis to guide the choice of the allowed rate of return percentile would be to calibrate the Dobbs model with plausible parameter values and then conduct the

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1 Wellington International Airport & Ors v Commerce Commission [2013] NZHC 3289, paragraph [1477].

requisite Monte Carlo analysis. In due course, the results from this initial analysis could potentially be refined by extending Dobbs' model to accommodate specific important features of regulated electricity networks.

## Key conclusions

In our previous report to Transpower, we explained that the process of setting allowed rates of return is fraught with estimation error. We also laid out an analytical case as to why setting an allowed rate of return too low (i.e. below a supplier's true WACC) is likely to lead to greater welfare loss than setting an allowed rate of return too high (i.e. above a supplier's true WACC). We contended that under these circumstances, it is prudent for regulators to err on the side of caution by adopting a WACC percentile above the midpoint of the estimated WACC range. Indeed, we showed that this view is widely accepted by regulators and policymakers overseas (e.g. in the UK and in Australia). In this report, we have gone further and shown that UK regulators actively choose WACC point estimates significantly above the midpoint of the range (because of the asymmetric consequences of mis-estimating the WACC). Finally, in our last report, we reviewed the most recent published literature on loss function analysis, by Dobbs. Dobbs' use of simulation modelling added further support to the practice of setting an allowed rate of return well above the midpoint of the WACC range.

When deciding whether to change the WACC IM percentile, we recommend that the Commission:

- have regard to this collective body of evidence, which supports an upward shift in the WACC percentile, and not a move closer to the midpoint of the range; and
- consider using Dobbs' loss function model as a starting point for evaluating its choice of WACC percentile (potentially with further extensions and refinements to the model in due course).

# 1 Introduction

On 31 March 2014, the Commerce Commission ('the Commission') issued a 'notice of intention' to do further work on the cost of capital input methodologies (IMs) that apply to electricity lines services, gas pipeline services and specified airport services regulated under Part 4 of the Commerce Act.

In issuing the notice of intention, the Commission invited interested parties to provide submissions on evidence regarding the appropriate weighted average cost of capital ('WACC') percentile that should be used under the cost of capital IMs. The Commission noted that parties are welcome to respond to points raised in submissions on the Commission's previous round of consultation.

In respect of this invitation for submissions, Transpower has asked us to comment on three specific issues.

- Firstly, Transpower has asked us to assess NZIER's claim, in its submission on behalf of the Major Electricity Users' Group (MEUG), that regulators overseas (in particular, those in the UK) have recently abandoned the practice of setting allowed rates of return above the midpoint on the WACC range.[2] This issue is addressed in section 2.
- Secondly, Transpower has asked us to comment on the Commission's suggestion that the "the obvious implication of transactions that exhibit a significant premium to the [RAB] value is that investors' behaviour indicates the relevant company's cost of capital is lower than the regulator's assumption".[3] This issue is discussed in section 3
- Thirdly, we have been asked to consider if and how a loss function approach could be implemented by the Commission to aid its selection of a point estimate from an estimated WACC range. This issue is addressed in section 4.

2 NZIER (2014), *WACC uplift: Preliminary advice, a note prepared for MEUG*, 13 March.

3 Commerce Commission (2014), *Invitation to have your say on whether the Commerce Commission should review or amend the cost of capital input methodologies*, 20 February, p.15.

# 2 Trends in international regulatory practice

## 2.1 Claims made by NZIER

In a number of places in its submission to the Commission on behalf of MEUG, NZIER claimed that there has been a recent shift by regulators overseas (particularly by those in the UK) against the long-held practice of setting allowed rates of return well above the midpoint of the WACC range estimated. For instance, NZIER stated that:[4]

> For example during the middle period of the 2000's regulators in the UK appear to have adopted this approach to 'uplift' WACC in various regulatory determinations but from late in the period the practice was replaced by tighter definitions of WACC components that gave a narrow mid-point range, defined by the components rather than from an arbitrary WACC uplift.
>
> Recent determinations, and current regulatory reviews in the UK have shied away from aiming high with estimates of WACC components and it appears to us that only one recent regulatory pricing review (the CER October 2013 mid-term review of EirGrid/ESB WACC) has considered a specific uplift, though this was not for reasons of estimation error.

And:[5]

> The lack of empirical evidence as to the benefits of raising WACC above mid-point estimates has led a number of overseas regulatory jurisdictions to now apply WACC rates at the mid-point (this is certainly now true in most of the regulated services in the UK)...This emerging practice provides some evidence (albeit of the crowd-sourcing variety) supporting the use of WACC rate at or below the mid-point of the regulators estimates.

NZIER has sought to create the impression that the Commission's approach to selecting a point estimate from its WACC range is out of line with current regulatory thinking and practice overseas. NZIER provided no supporting evidence to substantiate its claims. NZIER's claims are factually incorrect.

## 2.2 Evidence of UK regulatory practice

### 2.2.1 UK regulators continue to use an estimate above the midpoint

Contrary to NZIER's claims, recent regulatory practice from the UK supports the practice of choosing at least the 75th percentile of the WACC range. UK

4 NZIER (2014), *WACC uplift: Preliminary advice, a note prepared for MEUG*, 13 March, p.2.

5 NZIER (2014), *WACC uplift: Preliminary advice, a note prepared for MEUG*, 13 March, p.3.

regulators have not abandoned their established approach of choosing a WACC point estimate well above the midpoint of the estimated range. **Table 1** summarises key UK regulatory determinations since 2005.

**Table 1:** Summary of key WACC determinations by UK regulators since 2005

| Decision | Year | WACC range | Point estimate | Percentile |
|---|---|---|---|---|
| **Postcomm – Royal Mail** | 2005 | 5.40% to 8.60% | 8.00% | 81st |
| **Competition Commission & Civil Aviation Authority – Heathrow airport** | 2007, 2008 | 4.77% to 6.39% | 6.20% | 88th |
| **Competition Commission & Civil Aviation Authority – Gatwick airport** | 2007, 2008 | 4.91% to 6.77% | 6.50% | 85th |
| **Competition Commission & Civil Aviation Authority – Stansted airport** | 2008 | 5.20% to 7.54% | 7.10% | 81st |
| **Ofcom – Openreach** | 2009 | 9.25% to 10.75% | 10.10% | 57th |
| **Ofwat – Water-only and water-and-sewerage businesses in England & Wales** | 2009 | 2.90% to 5.40% | 4.50% | 64th |
| **Ofgem – Electricity distribution networks** | 2009 | 4.30% to 4.90% | 4.70% | 67th |
| **Competition Commission – Bristol Water** | 2010 | 3.80% to 5.00% | 5.00% | 100th |
| **Ofcom – Openreach*** | 2012 | 4.83% to 5.71% | 5.60% | 87th |
| **Civil Aviation Authority – Heathrow airport** | 2013 | 4.51% to 5.89% | 5.60% | 79th |
| **Civil Aviation Authority – Gatwick airport** | 2013 | 4.82% to 6.31% | 5.95% | 76th |
| **Ofwat – Water-only and water-and-sewerage businesses in England & Wales** | 2014 | 3.60% to 3.90% | 3.85% | 83rd |
| **Competition Commission – Northern Ireland Electricity** | 2014 | 3.30% to 4.10% | 4.10% | 100th |

*Sources: Postcomm (2005), 2006 Royal Mail Price and Service Quality Review – Initial Proposals, June, p.219; Postcomm (2005), Royal Mail Price and Service Quality Review – Final Proposals, December, p.145; Competition Commission (2007), BAA Ltd A report on the economic regulation of the London airports companies (Heathrow Airport Ltd and Gatwick Airport Ltd), 28 September, Appendix F, p.F40; Competition Commission (2008), Stansted Airport Ltd Q5 price control review, 23 October, Appendix L, p.L29; Civil Aviation Authority (2008), Economic Regulation of Heathrow and Gatwick Airports 2008-2013: CAA decision, 11 March, p.134; Civil Aviation Authority (2008), Stansted Airport CAA price control proposals, December, pp.57-58; Ofcom (2009), A new pricing framework for Openreach – Statement, 22 May, p.24; Ofwat (2009), Future water and sewerage charges 2010-15: Final determinations, 23 July, pp.127-128; Ofgem (2009), Electricity Distribution Price Control Review – Final Proposals, 7 December, p.49; Competition Commission (2010), Bristol Water plc – Final report, Appendix N, 4 August, p.N43; Ofcom (2012), Charge control review for LLU and WLR services Annexes, Statement, 7 March, p.129; Civil Aviation Authority (2013), Estimating the cost of capital: a technical appendix to the CAA's Final Proposal for economic regulation of Heathrow and Gatwick after April 2014,October, pp.88-89; Ofwat (2014), Setting price controls for 2015-20 – risk and reward guidance, January, p.24; Competition Commission (2014), Northern Ireland Electricity Limited, Final Determination, 26 March, p.13-40*

*Notes: * WACC range calculated by Frontier Economics using individual parameter values determined by the regulator.*

## Trends in international regulatory practice

In relation to the table above, we note the following points:

- The decisions canvassed span a wide range of regulated industries including: water; telecommunications; aviation; post; and electricity distribution and transmission.
- The decisions reported are those in which the regulator in question has first estimated a WACC range and then chosen a point estimate from that range. Some UK regulators — such as Ofgem, the Office of Rail Regulation (ORR), and Ofcom — do not always present in their decisions WACC ranges that make explicit the extent of their uncertainty over their WACC estimates. Some determinations simply derive a single point estimate. As it is impossible to infer the WACC percentiles that these regulators have in mind when making their decisions, determinations that do not report an estimated WACC range are not included in **Table 1**. However, as discussed below (see **Figure 1**), there is good evidence that these regulators have tended to apply some 'headroom' when estimating certain WACC parameters. This would have the same effect as "aiming high" within the WACC range.

**Table 1** shows that recent UK regulatory determinations have historically set allowed rates of return well above the midpoint of the range, and continue to do so. In fact, the determinations since 2010 have used WACC point estimates that represent the 76$^{th}$ to 100$^{th}$ percentiles — above the 75$^{th}$ percentile used by the Commission. NZIER's unsupported assertions that UK regulators have changed their approach since the mid-2000s, and "now apply WACC rates at the mid-point" is manifestly untrue.

### 2.2.2 Comparison with the Commission's IM approach

The Commission's IM approach is *less generous* to regulated suppliers than approaches used by UK regulators.

One might wonder whether the tendency by UK regulators to adopt higher percentiles within the WACC range than the Commission might be explained by 'tougher' determinations on individual parameters. Our analysis suggests this is not so. It is very difficult to make robust, direct comparisons between the level of returns allowed by UK regulators and the Commission because of country-specific circumstances.

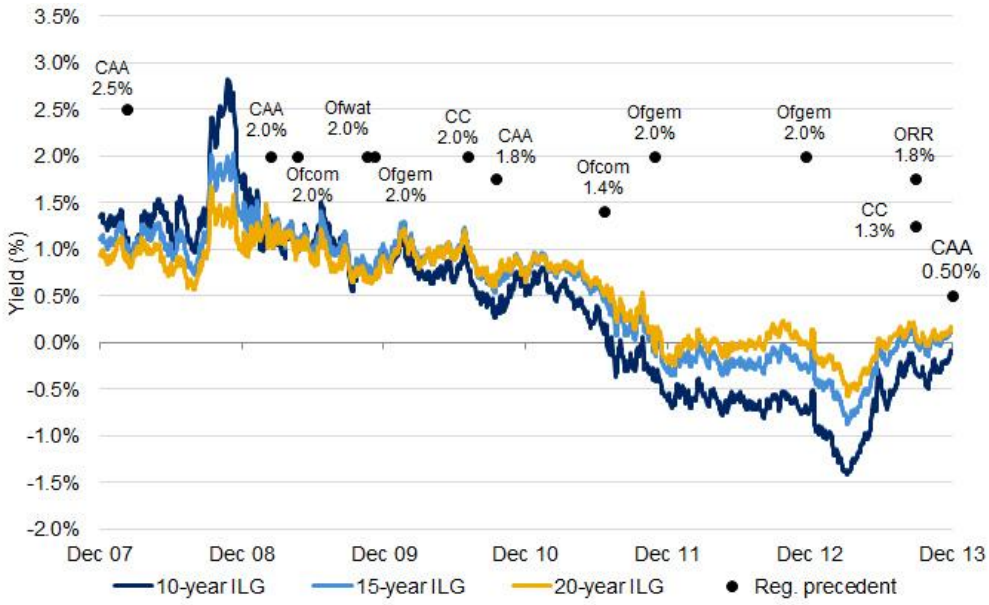
However, it is possible to compare the methodologies used to determine individual parameters and make inferences about the relative generosity of UK and New Zealand determinations. It is clear that in the case of a number of individual WACC parameters, the IM approach adopted by the Commission would, all else remaining equal, result in lower allowed rates of return than approaches adopted by regulators in the UK. The apparent tendency for UK regulators to choose higher WACC percentiles than the Commission cannot be

attributed to being tougher than the Commission when estimating individual WACC parameters.

### *Headroom in risk-free rate determinations*

It is well recognised that regulators in the UK have historically allowed some 'headroom' in risk-free rate determinations, in the sense that the risk-free rates assumed by regulators when estimating WACC have tended to be significantly higher than prevailing government bond ('gilt') yields. Recent analysis by Ofwat that compares gilt yields of different maturities and determinations by various regulators on the risk-free rate, reproduced below in **Figure 1**, demonstrates this clearly.

**Figure 1:** Recent UK regulatory determinations on the risk-free rate




*Source: Ofwat analysis of UK government bond yields and recent regulatory determinations. Ofwat (2014), Setting price controls for 2015-20 – risk and reward guidance, January, p.15*

As noted by the Commission's adviser, Professor Julian Franks, this practice by UK regulators has been motivated by the concern that government bond yields have recently been well below historical levels, are volatile over time, and may have a tendency to mean-revert.[6,7]

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6 Franks, J., Lally, M., Myers, S. (2009), *Recommendations to the New Zealand Commerce Commission on an Appropriate Cost of Capital Methodology*, 19 June.

7 There has been a recent move by some UK regulators — notably, the Competition Commission, Ofgem, and Ofwat — to put more emphasis on current market data than they have done in the past. However, it is clear that these regulators are still applying some headroom above prevailing rates.

## Trends in international regulatory practice

By contrast, under the IMs, the Commission applies an averaging period of one calendar month to prevailing government bond yields.[8] As a result, the Commission's determinations of the risk-free rate will tend to track prevailing market rates much more closely than the UK regulators' determinations. Given the significant downward trend in government bond yields over the past five years, the IM approach would have, over that period, resulted in much lower determinations of the risk-free rate than the headroom approach adopted by UK regulators.

### Term of the risk-free rate

The IM approach matches the term of the risk-free rate used to estimate WACC to the length of the regulatory period.[9] By contrast, UK regulators are less concerned about matching the term of the risk-free rate to the length of the regulatory period. Many use yield data on gilts of a range of maturities (i.e. from five years to 30 years) to inform their assessment of the risk-free rate, even though regulatory periods in the UK tend to be five to eight years long.[10]

Since the yield curve is usually upward-sloping, UK regulators' use of long maturity periods would tend to result in higher risk-free rate estimates than the Commission's approach of matching the term of the risk-free rate strictly to the length of relatively short (i.e. three to five years) regulatory periods.

### Joint treatment of the risk-free rate and market risk premium

The IM approach uses the long-term tax-adjusted market risk premium (TAMRP), which by definition is very stable over time.[11] At the same time, however, as explained above, the IM approach uses contemporaneous government bond yields (averaged over the relatively short period of a single calendar month), to estimate the risk-free rate. Under this approach, the estimated cost of equity of regulated suppliers (and the estimated WACC) will, all else remaining equal, tend to fluctuate in line with movements in the risk-free rate.

By contrast, UK regulators have tended to accept the view that expected equity market returns are relatively stable over time, even as the risk-free rate fluctuates.

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8 Commerce Commission (2010), *Input methodologies, Reasons paper*, p.439.

9 Commerce Commission (2010), *Input methodologies, Reasons paper*, p.439.

10 Among several others, see: Ofgem (2013), *Strategy decision for the RIIO-ED1 electricity distribution price control: Financial issues – Supplementary annex to RIIO-ED1 overview paper*, 4 March; Ofwat (2014), *Setting price controls for 2015-20 – risk and reward guidance*, January; Competition Commission (2014), *Northern Ireland Electricity Limited, Final Determination*, 26 March.

11 Although, the Commission did adjust the TAMRP temporarily, for the years 2010 and 2011, to account for the effect of the global financial crisis. See Commerce Commission (2010), *Input methodologies, Reasons paper*, p.506.

This means that as the risk-free rate falls, the market risk premium should increase (and vice versa). In other words, UK regulators have tended to assume a negative relationship between the risk-free rate and risk premiums, and have set allowed rates of return for regulated suppliers accordingly.[12]

As a result of this policy, allowed rates of return for regulated suppliers in the UK have tended to be fairly stable over time. Had UK regulators followed an IM-type approach, allowed rates of return would have fallen much more than they have in recent years, as government bond yields have trended down.

### *Approach to the cost of debt*

Analogous to its approach to the risk-free rate, under the IMs the Commission applies a one calendar month averaging period to current corporate borrowing rates when estimating the debt premium.[13] This results in cost of debt estimates that track closely movements in the corporate bond yields.

By contrast, a number of UK regulators including the Competition Commission (now the Competition and Market Authority), Ofwat, the CAA and the Northern Ireland Authority for Utility Regulation estimate a 'blended' cost of debt, calculated as the weighted average of embedded debt costs (i.e. the promised yield on existing debt) and the cost of new debt (i.e. based on market evidence on current borrowing rates for suitable comparator firms).[14] Ofgem places even more weight on historical evidence of borrowing costs: it uses a 10-year trailing average of iBoxx corporate bond yield indices reflecting A-rated and BBB-rated corporate bonds.[15] By placing some or all weight on historical borrowing rates, UK regulators dampen the effect of short-run movements in corporate bond yields. As with the approach to elements of the cost of debt, this tends to result in reasonably stable allowed rates of return over time.

**Figure 2** below plots the iBoxx bond yield index that some UK regulators (e.g. Ofgem, Ofwat, CAA) use to inform their cost of debt determinations.

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12 For a recent survey of how UK regulators have taken account of this relationship when determining allowed rates of return see Wright, S. (2012), *Review of Risk Free Rate and Cost of Equity Estimates: A Comparison of UK Approaches with the AER*, 25 October.

13 Commerce Commission (2010), *Input methodologies, Reasons paper*, p.461.

14 Competition Commission (2014), *Northern Ireland Electricity Limited, Final Determination*, 26 March; Ofwat (2014), *Setting price controls for 2015-20 – risk and reward guidance*, January; Civil Aviation Authority (2013), *Estimating the cost of capital: a technical appendix to the CAA's Final Proposal for economic regulation of Heathrow and Gatwick after April 2014*,October; NIAUR (2012), *Northern Ireland Electricity Transmission and distribution price controls 2012-17 – Final determination*, 23 October.

15 Ofgem (2013), *Strategy decision for the RIIO-ED1 electricity distribution price control: Financial issues – Supplementary annex to RIIO-ED1 overview paper*, 4 March.

**Figure 2:** iBoxx corporate bond yield index


*Source: Data obtained from Markit*

*Notes: The iBoxx index shown in the graph above is a simple average of the iBoxx Non-financials 10+ indices for A-rated and BBB-rated corporate bonds.*

The data indicates that the yields on A-rated and BBB-rated corporate bonds have declined over the past five years, from a peak in late 2008 coinciding with the height of the global financial crisis. The long-term rolling average and blended cost of debt approaches used by UK regulators has dampened the effect of this recent decline. By contrast, an IM-style approach would have resulted in significant reductions in the cost of debt allowed over the same period.

## *Implications*

We have identified a number of key methodological differences between the approaches used by the Commission and several UK regulators. In these areas, given developments in financial markets over the past five years, the IM approach would have resulted in lower allowed rates of return than the approaches actually adopted by UK regulators (leaving aside the choice of WACC percentile). Yet, over the same period, many of those UK regulators have adopted higher WACC percentiles than the Commission. In view of the evidence, it cannot be argued that the reason UK regulators have tended to adopt higher WACC percentiles than the Commission is because those regulators have been tougher when estimating individual WACC parameters. The UK regulators have tended to be more generous than the Commerce Commission on both counts.

# 3 Reasons why a regulated supplier's enterprise value may exceed its RAB

When considering possible empirical evidence on the most suitable WACC percentile in its February 2014 consultation paper, the Commission referred to Northington Partners' observation that the 2013 Powerco transaction implied an enterprise value (EV) well in excess of the business's RAB. When interpreting this evidence, the Commission suggested the obvious implication is that the rate of return required by investors in order to commit capital to the firm was lower than the rate allowed by Commission.

In fact there are many alternative, plausible explanations for an EV premium over the RAB; the one posited by the Commission is only one of many. The EV may exceed the RAB for one or more of the following reasons:

- The acquirer may have expected greater efficiencies to be generated by Powerco than was assumed by the Commission when setting its price-quality path. At the 2012 default price-quality price path (DPP) reset, which Powerco was subject to at the time of the transaction, the Commission assumed a rate of change in partial productivity of zero.[16] Yet, under the DPP framework, any efficiencies achieved by suppliers are kept by the business at least until the next regulatory reset. This should provide some incentives for the business to generate efficiencies over the regulatory period. Therefore, it would not have been unreasonable for the acquirer to anticipate some efficiency gains by Powerco beyond the steady-state assumed by the Commission.
- The purchaser may have taken account of other intangible assets, or potential for growth in the RAB (relative to the current RAB value), when valuing the investment.
- The new owner may have anticipated revenues from, and growth in, unregulated parts of the business (i.e. those not included within the RAB). Powerco has a number of divisions. One of these divisions, Powerco Transmission Services (PTS), builds and maintains high-voltage transmission lines, and connects energy generation sites, particularly wind farms, to the National Grid. The commercial activities of PTS are not regulated by the Commission.
- The buyer may have taken into account that it was investing in a gas pipeline business (GPB) as well as an electricity distribution business (EDB), and may have judged the GPBs to be riskier (and, therefore, to have a higher

16 Commerce Commission (2012), *Resetting the 2010-15 Default Price-Quality Paths for 16 Electricity Distributors*, 30 November.

associated WACC) than the EDBs.[17] If this were so, the WACC of a diversified business (i.e. one that operates gas pipelines as well as provides electricity distribution) should be higher than the WACC of a pureplay EDB.

- The acquirer may have been the victim of the 'Winner's Curse', and may have simply paid over the odds for its stake in Powerco.
- The Commission may have allowed a rate of return above Powerco's true WACC.

It is impossible, in practice, to distinguish which of these reasons really apply in Powerco's case. Therefore, the Commission should resist the urge to jump to the conclusion that excess returns is the "obvious" explanation for any observed premium.

Furthermore, this anecdote cited by the Commission is a single observation. There is no sound basis for inferring, from this one case, that the Commission has allowed over-generous returns for the entire industry.

17 The Commission itself accepts that gas pipeline businesses may be riskier than electricity distribution businesses. See, for instance, Commerce Commission (2010), *Input methodologies, Reasons paper*, p.167.

# 4 Application of a 'loss function' approach

The Commission's notice of intention invited submissions to provide empirical or analytical evidence regarding the appropriate WACC percentile, such as the use of 'loss functions' that compare the social harm caused by over- versus under-estimating the WACC for an electricity network business. While our review has not identified a practical application of the loss function approach to electricity networks, we note that:

- There is wide acceptance amongst policy-makers and regulators of the proposition that the cost of under-compensating electricity networks is greater than the reverse;
- The analytical framework developed in our previous report for Transpower provides strong theoretical grounds for this widely-accepted proposition, even where there are no explicit constraints on inefficient investment; and
- The Dobbs model (also discussed in our previous report) shows how the optimal allowed regulatory rate of return is likely to be well above the 50$^{th}$ percentile under most relevant conditions. Further, where the elasticity of demand for the relevant service is relatively low (as it is for electricity), the optimal WACC is likely to be even higher still.
- The Dobbs model provides a useful starting point methodology for practically estimating the optimal allowed rate of return percentile for regulated businesses. From there, the model could be further developed to better reflect the characteristics of electricity network services.

These points are expanded upon below.

## 4.1 Wide acceptance of asymmetric costs

The asymmetry of social harm caused by under- or over-estimating an electricity network business's true WACC appears to have been widely accepted by regulators and policy-makers. For example, the Australian Productivity Commission recently made a number of observations in its Inquiry Report on Electricity Network Regulatory Frameworks that were supportive of the notion that the costs of under-compensating energy network businesses are likely to be higher than the costs of over-compensating such businesses:[18]

> Under incentive regulation, under-remuneration is likely, ultimately, to lead to larger costs than over-remuneration of an equal magnitude, This is because the costs of underinvestment affect the long-run provision of reliable network services to consumers.

[18] Productivity Commission (2013), *Electricity Network Regulatory Frameworks, Inquiry Report*, Volume 1, No.62, 9 April, p.31.

Likewise:[19]

> [W]hile setting the regulatory WACC too low would lower prices to end users in the short run, it might make it difficult for firms to recover their efficient costs in the long term. This would contravene the revenue and pricing principles in the National Electricity Law, and in any case would not be in the *long-term* interest of consumers. [Emphasis in original]

And:[20]

> [T]he determination process should... recognise that, over time, under-compensation of network businesses resulting from regulatory errors is likely to have greater cots for customers and the wider community than 'symmetric' over-compensation...

Similarly:[21]

> Setting the cost forecast above the best estimate reflects the fact that all estimates have errors, and that in this case, the impact of errors in asymmetric. In other words, the cost of providing a high forecast is less than that of a low forecast. This is also consistent with setting the benchmark performance of the business below the frontier. This approach would create an expected rent for the business, but given uncertainty over costs forecasts would also insure the community against the risks of under-investment or poor management of assets.

Our previous report on behalf of Transpower documented that other regulators in Australia and the UK have expressed similar views.[22]

In 2007, the Commerce Commission itself commented (in its Draft Decisions Paper on the authorisation of gas distribution services by Powerco and Vector) that:[23]

> The Commission recognises that the consequences of underinvestment in infrastructure by regulated businesses can be more severe than the consequences of excessive prices to consumers. The consequences of underestimating WACC may, therefore, be more serious than overestimation of the WACC. The Commission acknowledges that there is uncertainty surrounding the true WACC value. Rather than addressing this issue through overestimation of certain parameters used in estimating the WACC, the Commission considers that it is more appropriate to select a WACC value from the upper end of the estimated range...

However, in its final Decision, the Commission noted that because there was no empirical evidence to allow reliable estimation of the appropriate form or parameters of such a loss function, the Commission decided to not adopt this

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19 Productivity Commission (2013), p.206.

20 Productivity Commission (2013), p.223.

21 Productivity Commission (2013), p.224.

22 Frontier Economics (2014), *Evidence in support of setting allowed rates of return above the midpoint of the WACC range, A report prepared for Transpower*, March, section 5.

23 Commerce Commission (2007), *Authorisation for the Control of Supply of Natural Gas Distribution Services by Powerco Ltd and Vector Ltd*, Draft Decisions Paper, 4 October, para 1093, p.267.

approach for the Authorisation.[24] Nevertheless, taking into account the likelihood of asymmetric losses associated with mis-estimating WACC, the Commission chose to select a WACC value from the upper half of the estimated range.[25]

## 4.2 Analytical case for an asymmetric loss function

Our previous report on behalf of Transpower provided strong grounds for inferring that the loss function applicable to electricity network investment incentives is skewed in the direction of higher losses from under-compensating network investors, even in a regulatory environment lacking direct mechanisms to prevent over-investment (such as *ex ante* approvals).[26]

Our previous report explained that:

- An allowed rate of return set below a firm's true WACC would tend to discourage network investment whereas an allowed return set above the true WACC would tend to encourage excessive network investment.
- Demand for electricity network services – being derived from demand for electricity – is variable, resulting in a downward-sloping demand or load duration curve (Figure 3).
- The social costs of unserved energy are high, but tend to decline (on a $/MWh unserved basis) as the duration of a non-supply episode increases.
- Therefore, the marginal value of electricity network capacity (in $/MW) also tends to decline as the network is further augmented to maintain supply under progressively more extreme conditions (Figures 4 and 5).
- Accordingly, the welfare losses from a given amount (in MW) of over-investment in an electricity network will be smaller than the welfare losses from the same amount of under-investment (Figure 6). This follows from the convexity of the marginal benefits of transmission combined with an assumed constant marginal cost (also in $/MW) of transmission.

Our previous report cited relevant literature or applied mathematical logic to support each of these elements in our analytical case.

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24 Commerce Commission (2008), *Authorisation for the Control of Supply of Natural Gas Distribution Services by Powerco Ltd and Vector Ltd*, Decisions Paper, 30 October, para 761, p.182.

25 Commerce Commission (2008), *Authorisation for the Control of Supply of Natural Gas Distribution Services by Powerco Ltd and Vector Ltd*, Decisions Paper, 30 October, para 759, p.181

26 Frontier Economics (2014), section 3.

## 4.3 Dobbs model

Our previous report discussed the approach of Dobbs (2011) to estimating the optimal allowed rate of return for a regulated supplier using a Monte Carlo modelling approach.[27] Dobbs found that given regulated suppliers tend to own both sunk assets as well opportunities for new deferrable and non-deferrable investments, the optimal allowed rate of return would be considerably higher than the 50th percentile of the estimated WACC range. In Dobbs' benchmark case, the optimal allowed rate of return was equivalent to the 82nd percentile of the estimated WACC range.[28]

Without repeating in full the discussion in our previous report, the key reason for the optimality of an allowed rate of return above the midpoint of the estimated WACC range is the asymmetry between:

- the welfare costs of setting the rate of return too low, which arise from a beneficial investment not proceeding and the consequent loss of consumer surplus; and
- the (much smaller) welfare costs of setting the rate of return too high, resulting in a small reduction in the consumption of regulated services.

Dobbs conducted a range of sensitivities on all of the key parameters used in the Monte Carlo simulation modelling. Crucially, he found that where demand for the service was less elastic than assumed in the benchmark case, the optimal allowed rate of return was higher. Specifically, where elasticity changed from -3 to -1.5 (still relatively elastic), the optimal rate of return increased from the 82nd percentile (Case 2) to the 90th percentile (Case 9), other things being equal.[29] The intuition for this result is that less elastic demand means that the allocative inefficiency caused by prices being higher than otherwise due to the allowed rate of return being 'too high' is lower than if demand were more elastic.

We note that estimates of demand elasticities for electricity suggest that demand is relatively inelastic. For example, the Electricity Authority noted recently a short-term elasticity of -0.01 was 'not unreasonable' given the penetration of advanced metering.[30] Such an elasticity would effectively imply next to no allocative inefficiency from setting the allowed rate of return for networks (and effectively, prices) higher than necessary to induce investment.

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27 Dobbs, I.M. (2011), 'Modeling welfare loss asymmetries arising from uncertainty in the regulatory cost of finance', *Journal of Regulatory Economics* 39, pp.1-28.

28 Dobbs (2011), Table 3, p.21.

29 Dobbs (2011), Table 3, p.21.

30 Electricity Authority (2014), *Transmission pricing methodology review: Beneficiaries-pay options, Working Paper*, 21 January, para 7.62. p.42.

On behalf of the MEUG, NZIER proposed the use of a long-run elasticity in relation to the prices of sunk investment, the presumption being that demand is more price-elastic in the long term than in the short term.[31] However, NZIER did not provide an estimate of long run elasticity.

In a survey of demand elasticity estimates, Fan and Hyndman (2011) noted elasticities between -0.002 and -0.7, depending on the type of customer and the time frame involved.[32] Drawing on Fan and Hyndman's work, the Australian Productivity Commission adopted an elasticity range of -0.2 to -0.4 in the short term and -0.5 to -0.7 in the long term.[33] Note that all of these estimates are much smaller than the -1.5 used by Dobbs in his sensitivity analyses.

The use of any of the elasticity estimates noted above would tend to, other things being equal:

- increase the asymmetry of the loss function;
- reduce the loss from setting the allowed rate of return for electricity network businesses above the true WACC; and
- increase the optimal allowed rate of return for electricity network businesses.

## 4.4 Practical application of loss functions

As noted above, the Commission refrained from applying a loss function approach in its 2008 final Decision on the authorisation of gas distribution services by Powerco and Vector. At that time, the Commission explained its decision on the basis that there was no empirical evidence to allow reliable estimation of the appropriate form or parameters of such a loss function.[34]

Since that decision, Dobbs (2011) has provided a clear framework not only for developing an allowed rate of return loss function for regulated businesses, but also for utilising that function to estimate the optimal allowed rate of return percentile within a range using a Monte Carlo modelling approach.

We consider that a reasonable first step in applying loss function analysis to guide the choice of the allowed rate of return percentile would be to populate the Dobbs model with suitable parameters before conducting the Monte Carlo

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31 NZIER (2014), *Beneficiaries-pay options, Advice to MEUG regarding Electricity Authority Beneficiaries-pay options working paper (21 January 2014)*, March, 2.3.3, p.7.

32 Fan, S. and Hyndman, R. (2011), 'The price elasticity of electricity demand in South Australia', *Energy Policy*, Vol. 39, pp. 3709–19.

33 Productivity Commission (2011), *Carbon Emission Policies in Key Economies, Research Report*, 9 June, *Appendix L, Demand-side analysis for electricity*, Box L.2., p.4.

34 Commerce Commission, *Authorisation for the Control of Supply of Natural Gas Distribution Services by Powerco Ltd and Vector Ltd*, Decisions Paper, 30 October 2008, para 761, p.182.

analysis. The relevant parameters that would need to be calibrated within Dobbs' existing model would include:

- The length of the regulatory period;
- The form of the demand function for network services, including the elasticity of demand and the rate of growth in demand;
- The network investment cost function (fixed and marginal costs) and relevant rates of depreciation;
- The deferability and frequency characteristics of different types of network investment opportunities; and
- The business's objective function.

In the first instance, it would be necessary to assume the magnitude or nature of some of these parameters, as not all are available or immediately apparent. For example, ascertaining the demand for network services is complicated, as this is effectively derived from the demand for electricity. The demand for network services is important because not only does it influence a regulated supplier's investment decision, but it also feeds into the value of consumer surplus provided by an investment. The analytical framework set out in our previous report explained some of the many considerations relevant to determining matters such as the marginal social value of network capacity.

Having applied the Dobbs' model with the use of some plausible parameter values to provide an indication of the optimal percentile of the allowed rate of return, a subsequent step could involve extending the model so that it better captures the more specific characteristics of electricity network services. This would provide the model with more appropriate parameters and form than those assumed in the initial application.

Based on the analytical framework discussed previously, future refinement of the Dobbs model could potentially involve:

- Investigating if alternative distributions for the true WACC of the supplier are reasonable and, if so, deriving alternative specifications of the loss function under those alternative distributions. Dobbs assumes that required rates of return are normally distributed.
- Estimating a more accurate firm objective function – such as by considering the extent to which an allowed rate of return set below a firm's true WACC would discourage network investment, and the relationship between allowed rates of return and the timing of network investment.
- Relaxing the assumption of no over-investment – such as by explicitly considering the extent (if any) to which an allowed rate of return set above a firm's true WACC would encourage excessive network investment, or the acceleration of planned investments.

- Deriving the shape of the relevant load duration curve – which would feed in to a more accurate calculation of the demand for network services and the welfare implications of under- and over-investment in network assets.
- Estimating the relationship between the level and timing of network investment and the frequency and duration of supply interruptions experienced by end-use customers. Again, this would influence the welfare implications of different levels of network investment.
- Estimating the extent to which the social costs of unserved energy decline (on a $/MWh unserved basis) as the frequency and duration of non-supply episodes increase. This would influence the welfare implications of different levels of network investment.
- Following from the above, estimating the extent to which the marginal value of electricity network capacity (in $/MW) declines as the network is further augmented to maintain supply under progressively more extreme conditions. This would influence the welfare implications of different levels of network investment.

Such augmentations to Dobbs' model, if feasible to implement, may help provide a more accurate assessment of the extent to which the allowed rate of return for regulated suppliers should be set above the 50$^{th}$ percentile estimate of the firm's WACC. Even if such extensions to the model prove too difficult to implement directly, the issues canvassed above could be taken into account in qualitative way when selecting the final point estimate.

We note that in its report urging the Commission to use a loss function approach for Powerco and Vector, LECG simply commented that the use of a 75$^{th}$ percentile estimate was consistent with an asymmetric linear loss function where the costs of underestimating the true WACC were three times the costs of overestimating the true WACC.[35] LECG suggested that if the costs of underestimation were nine times the costs of overestimation, a 90$^{th}$ percentile estimate would be appropriate. This highlights that, absent empirical evidence, qualitative assessment is required to determine how much above the mid-point the Commission should select the WACC percentile, and that it may be the case that the optimal allowed rate of return is above the 75$^{th}$ percentile.

35 LECG (Tony van Zijl), *Response on behalf of Vector Limited to the Commerce Commission's estimate of WACC in the Draft Authorisation for the Control of Supply of Natural Gas Distribution Services by Powerco Limited and Vector Limited*, 26 November 2007, p.8.

## Application of a 'loss function' approach

FRONTIER ECONOMICS | MELBOURNE | SYDNEY
Frontier Economics Pty Ltd 395 Collins Street Melbourne Victoria 3000
Tel: +61 (0)3 9620 4488 Fax: +61 (0)3 9620 4499 www.frontier-economics.com
ACN: 087 553 124 ABN: 13 087 553 124