



Determining the Appropriate Percentile for Setting the Regulatory WACC

A Report for Powerco

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Executive Summary

In March this year, the Commerce Commission New Zealand (the Commission) issued a 'notice of intention' to undertake further analysis on the cost of capital input methodologies (the IMs) that apply to electricity lines services, gas pipeline services and specified airport services regulated under Part 4 of the Commerce Act.

Specifically, the Commission is reviewing the appropriateness of setting the weighted average cost of capital (WACC) at the 75th percentile of its estimate range.

Powerco has engaged NERA Economic Consulting (NERA) to consider this issue, which has, essentially, three elements:

1. What is the rationale for setting a regulatory WACC above an (unbiased) midpoint estimate?
2. What can be said about the Commission's midpoint WACC estimate relative to an unbiased estimate of firms' cost of capital? And
3. How could the 'optimal' percentile point estimate for the regulated WACC be empirically established?

The rationale for using the 75th percentile

There is an inherent a risk that any regulatory WACC will deviate from firms' cost of capital by an indeterminate amount. Misspecifications in the WACC will result in social losses by virtue of establishing prices and investment incentives that deviate from the 'optimal' levels.

If the social losses of setting the regulatory WACC either too high or too low are symmetric, then it is appropriate to set the WACC on the basis of an unbiased midpoint estimate of firms' cost of capital. However, to the extent that the social losses are asymmetric, it will be appropriate for a prudent regulator to err on the side of caution and set the regulatory WACC either:

- higher than an unbiased midpoint estimate if the social costs of setting the WACC too low are higher than those of setting it too high; or
- lower than an unbiased midpoint estimate if the social costs of setting the WACC too low are lower than those of setting it too high.

The Commission's approach of using the 75th percentile has been generally accepted as appropriate given the widely held view that the social losses associated with setting the WACC too high will be lower than those associated with setting it too low.

The lack of supporting empirical analysis for the 75th percentile was noted by the High Court. However, before considering the way in which any robust empirical analysis may be undertaken, it is useful to reiterate that there are strong qualitative reasons to believe that setting the WACC in the upper part of its estimated range is appropriate.

The social costs associated with misspecifying the WACC fall into two broad categories:¹

- the deadweight loss associated with setting regulated tariffs varying from the tariffs that would prevail under a correctly specified WACC; and
- the costs incurred over time as a result of distorting firms' investment decisions, which can involve:
 - *in the case of setting the WACC too high*: the value of additional resources committed to 'excess' investment (offset to some extent by the additional benefits to consumers of this investment); or
 - *in the case of setting the WACC too low*: the reduction in consumer welfare associated with a lower quality (or reliability) of supply (offset to some extent by the savings of deferring or avoiding capital expenditure).

Considering first the deadweight loss associated with setting the regulatory WACC (and therefore tariffs) at levels that are either too high or too low: if one starts from the premise that the deadweight loss is minimised by setting the regulatory WACC equal to the cost of capital, then specifying a WACC that is either too high or too low will increase the deadweight loss.

However, the increase in the deadweight loss associated with setting the WACC too high is likely to be relatively small, as network charges comprise only a component of end-user charges and electricity demand is generally considered to be relatively price insensitive.

The deadweight loss associated with setting the WACC too low may be higher, as establishing prices at levels that are insufficient for firms to recover all their costs may risk triggering financial distress and ultimately leading to severe service disruptions.

Turning to the costs associated with distorting investment decisions, these are also likely to be asymmetric. Specifically, the costs associated with setting the WACC at a rate below the regulated firms' cost of capital is likely to result in a larger social loss than a setting it above the cost of capital by a similar magnitude. This is due to the following relationships:

- a declining marginal benefit and increasing marginal cost relationship indicates that the net social loss associated with reducing investment by a certain dollar value is likely to be higher than the net social loss associated with increasing investment by the same amount; and
- certain features of the regulatory framework, such as the ex-ante review of capex, limit excessive investment expenditure whereas the corresponding requirements for minimum investment levels (which relate to the need to meet reliability standards) may be less adequate for maintaining 'optimal' investment levels.

Taken together, these factors suggest that the net social cost is likely to be asymmetric in the sense that setting the WACC too high is likely to be less harmful than setting it too low.

¹ There may be additional costs if there is a risk of financial distress as a result of firms being unable to fully recover their costs. However, we have not explicitly considered these in this paper.

Under these conditions, a prudent regulator would aim to establish a WACC that is more likely to be above than below the cost of capital.

The Commission should be reassured by the fact that the nature of this asymmetry appears to be widely accepted by regulators and consultants as well as supported by the (limited) empirical analysis that has been undertaken to date.

Comment on the Commission's WACC methodology

The Commission's ultimate focus must be on the overall rate of return to businesses. This suggests that if certain components of the methodology result in a risk of under-estimating the cost of capital then it is imperative that other aspects offset this. On this basis, it would be inappropriate to consider whether the WACC should be set above or below the Commission's midpoint estimate without taking account of any bias inherent in that midpoint estimate.

If the Commission's WACC estimate methodology provides an unbiased estimate of the cost of capital, then:

- setting the WACC at the midpoint estimate would balance the probability of firms receiving more or less than their cost of capital; and
- the Commission may choose to set the regulatory WACC above its unbiased estimate if it concurs that the social loss associated with setting the WACC too low is higher than that associated with setting the WACC above the cost of capital.

However, it is highly likely that the Commission's WACC underestimates firms' required returns:

- the Capital Asset Pricing Model (CAPM) has been shown to provide biased results for firms with betas that differ significantly from one. A recent study in the US has suggested that the bias may result in the cost of equity for energy utilities being underestimated by 400 basis points;²
- the IMs do not compensate firms for the asymmetric risks associated with the distribution of returns being truncated on the upside without an offsetting downside truncation. Regulation prevents returns from reaching excessive levels while leaving firms exposed to the risks associated with such events as natural disasters and asset stranding; and
- - the use of the five year debt term introduces an inconsistency in the approach to estimating the costs of equity and debt, resulting in a downward bias.

Taken together, these factors suggest that setting the WACC at the midpoint level would result in firms being more likely to be undercompensated for their cost of capital.

When the likelihood of asymmetric social losses is taken into account, this strongly suggests the Commission would be prudent to set a WACC above its midpoint estimate.

² Chrétien, Stéphane and Coggins, Frank (2011) "Cost of Equity for Energy Utilities: Beyond the CAPM," Energy Studies Review: Vol. 18: Iss. 2, Article 2, abstract.

Issues with empirically estimating the 'optimal' WACC percentile

The qualitative analysis of the issues does not provide a strong case for setting the WACC at the 75th percentile of the range in preference to, for example, the 70th or 80th percentile. For this reason, the Commission is interested in undertaking an empirical analysis of the 'optimal' extent to which the WACC should deviate from its midpoint estimate.

Achieving a defensible and broadly accepted 'optimal' WACC estimate is likely to be a complex and controversial task. In our view, the timeline contemplated in the 'notice of intention' is extremely ambitious and is unlikely to provide sufficient time to:

- develop a framework for analysing the issues;
- identify the relevant data and postulate assumptions; and
- undertake the analysis in a transparent and rigorous manner.

A more useful objective within the timeframe set may be to explore the envisaged framework with a view to identifying:

- the range of benefits and costs to be included in the analysis;
- the availability of information regarding how these costs and benefits would be affected by deviations between the regulatory and actual WACCs; and
- the degree of confidence the Commission expects to be able to achieve through such analysis.

The perceived rigour of undertaking an empirical evaluation of the optimal percentile should not detract from the fact that any such analysis will remain heavily reliant on a range of estimates and assumptions. Any resultant estimate will be only as meaningful as the information and assumptions underpinning it. The output of such an exercise is therefore likely to be a range for the 'optimal' percentile rather than a definitive point.

Furthermore, although the High Court focused on the use of the 75th percentile as a way of addressing the potential asymmetry in the social loss associated with setting the WACC too high versus too low, in reviewing the appropriateness of the 75th percentile, it is important to bear in mind that this approach addresses a wider range of issues. Specifically, the use of the 75th percentile also offsets an inherent downward bias in the Commission's WACC methodology and provides some compensation to businesses for the truncated distribution of potential returns.

It is, therefore, inappropriate to review the use of the 75th percentile in isolation. If the use of the 75th percentile were to be altered on the basis of empirical analysis that is narrowly focused on the asymmetric losses associated with setting the WACC higher or lower than the cost of capital, the Commission would be remiss if it did not then revisit the wider WACC methodology. Reviewing certain aspects of the IM framework in isolation may also inadvertently increase the cost of capital by increasing the perceived regulatory risk associated with investing in New Zealand's regulated businesses.

1. Introduction

In March 2014, the Commerce Commission New Zealand (the Commission) issued a ‘notice of intention’ to undertake further analysis on the cost of capital input methodologies (the IMs) that apply to electricity lines services, gas pipeline services and specified airport services regulated under Part 4 of the Commerce Act.

Specifically, the Commission is reviewing the appropriateness of the weighted average cost of capital (WACC) percentile that has been used in setting the regulated price-quality paths. This follows the High Court’s concerns regarding the use of the 75th percentile, rather than the mid-point WACC estimate.

The Commission has summarised the view of the Court as follows:

In considering MEUG’s arguments about the use of the 75th percentile, the court:

9.1 was sceptical that the use of a WACC estimate substantially higher than the mid-point was necessary to promote incentives to invest and innovate, noting that “[i]f anything an abundance of capital is likely to lead to wasteful investment”;

9.2 considered that the use of the 75th percentile WACC involves the likelihood that suppliers will earn excess returns, and therefore might be at odds with the section 52A(1)(d) objective of limiting the ability of regulated suppliers to earn excessive profits;

9.1 acknowledged that there was strong support for our choice to use the 75th percentile, including from our experts, but highlighted that there was not analysis or empirical evidence justifying that choice;

9.1 noted that MEUG did not present any evidence in support of using the mid-point instead; and

9.1 was therefore not satisfied that applying a mid-point estimate would lead to a ‘materially better’ cost of capital IM.

Within this context, Powerco has asked NERA Economic Consulting (NERA) to consider:

- whether there is a sound economic rationale for setting a regulatory WACC at a level higher than an unbiased estimate of the cost of capital;
- whether there are additional reasons the Commission might choose to set the regulatory WACC above its own midpoint estimate; and
- the merits and practicability of undertaking an in-depth empirical estimate of the ‘optimal’ percentile within the timeframe envisaged by the Commission.

This report sets out NERA’s assessment of each of these issues and is structured as follows:

- Section 2 provides background to the Commission’s review, including summarising the concerns raised by the High Court in its merit review of the Commission’s methodology;

- Section 3 discusses, qualitatively, the rationale behind the general perception that the social loss associated with under-compensating firms is likely to be higher than that associated with over-compensating them;
- Section 4 considers the biases inherent in the Commission's WACC estimation methodology and concludes that setting the WACC at the Commission's midpoint estimate would be equivalent to setting a WACC that is more likely to under-compensate regulated firms;
- Section 5 sets out a framework for using a loss function to estimate the optimal point estimate of the WACC within the Commission's estimation range. Given the timeframe for this submission, it was not feasible to undertake such analysis as part of this engagement. However, this Section sets out a potential way forward.

2. Background

2.1. The IM determination

Under Part 4 of the *Commerce Act 1986*, non-exempt suppliers of electricity lines services and suppliers of gas pipeline services are subject to default/customised price and quality regulation. In December of 2010, the Commission published its *Input Methodologies (Electricity Distribution and Gas Pipeline Service)*, which set out the rules, requirements and processes applying to the regulation of those services. The purpose of these methodologies was to give certainty to the suppliers of regulated services and consumers as to how the regulatory system will be applied, and to promote outcomes in regulated markets that are consistent with those produced in competitive markets.

In relation to cost of capital estimates, the input methodologies state that the Commission will adopt the 75th percentile of the WACC distribution. While noting that this was higher than the mid-point estimate, the Commission considered the choice prudent to ensure, by allowing for possible errors in the estimation of the WACC, that regulated suppliers have incentives to invest because efficient investment is to the long-term benefit of consumers.

In support of this the Commission tested the cost of capital estimates produced by the input methodologies to ensure they were reasonable and commercially realistic. In particular, the Commission tested its estimate against independent estimates of the cost of capital in New Zealand, against regulatory decisions (especially in the UK and Australia), and against historic and expected returns for the New Zealand market. According to the Commission, these tests confirmed that the input methodologies provides estimates of the cost of capital that are expected to provide suppliers of regulated services with sufficient returns to incentivise innovation and investment, while ensuring suppliers are limited in their ability to extract excessive profits.

2.2. The High Court decision

The input methodologies were considered by the High Court in *Wellington International Airport Ltd and others v Commerce Commission* [2013] NZHC 3289. Amongst other things, the High Court considered the appropriateness of the Commission's approach to using the 75th percentile of the WACC distribution. The High Court noted that use of this percentile in the manner set out in the input methodologies involved the likelihood that regulated suppliers would earn excess returns, which was at odds with the section 52A(1)(d) purpose of limiting the ability of these suppliers to extract excess profits. The Court therefore considered whether this result was justified by fear of failure to achieve the section 52A(1)(a) outcome of providing regulated suppliers with incentives to invest and innovate. This question was considered within the context of what best promotes the long-term benefit of consumers, the overriding purpose of Part 4 of the Act.

In considering the issue, the High Court noted that no supporting analysis was provided by the Commission for adopted the 75th percentile, and there was a similar lack of reference to any research literature in the various citations provided by suppliers to submissions made on their behalf. The court noted that the rationale for the Commission's approach comes closest to having a clear basis in terms of the loss function that was discussed at the Cost of Capital Workshop. For example, Professor van Zijl noted that among the loss functions that one

could postulate was a simple linear one where ‘the cost of being too low is three times the cost of being too high, which is equivalent to the 75th percentile. If it was 90% the ratio would be six.’ However, the High Court noted the absence of any supporting material in the workshop, or any of the related submissions, which gave flesh to this idea or explained the reasoning behind the ratios provided.

Ultimately, while noting that there were some in-principle arguments which cast doubt on the Commission’s position of adopting the 75th percentile, the High Court was not persuaded that applying another estimate, such as a mid-point WACC estimate, would be materially better in meeting the purpose of Part 4. It noted that the in-principle arguments suffered from the same lack of empirical support as the Commission’s approach. In addition, the High Court stated that regulated history should be taken into account, and in the face of the Parliamentary recognition of the importance of incentives to invest, it was understandable that in establishing the new regulatory regime the Commission would not wish to run the risk of deterring investment by providing too low a rate of return.

In reaching its decision not to amend the input methodologies in respect of the use of the 75th percentile, the High Court was mindful that the methodologies would be reviewed. The Court stated its expectation that at the time of such review the scepticism about using a WACC substantially higher than the mid-point would be considered by the Commission. The Court considered that further empirical analysis and evidence of experience was needed, citing the following passage from the Telstra case as being pertinent:³

...there exists as a matter of theory the potential for asymmetrical consequences should the WACC be set too low or too high. Which of these consequences will carry with it the greatest social damage is not a matter solely for theory, however, but for robust empirical examination, well-guided by theory, of the actual facts of any particular case.

2.3. Current review

Following on from the High Court’s decision, the Commission initiated a review of its cost of capital IMs. To that end, the Commission has invited submissions providing:⁴

- empirical or analytical evidence regarding the appropriate WACC percentile. For example, the Court referred to the possibility of using a ‘loss function’ approach which would estimate the relative social harm done by over-estimating and under-estimating the WACC, to determine the appropriate percentile; and
- any additional considerations (supported by evidence) that differ between sectors, which might affect the appropriate WACC percentile. Possible examples may include *ex ante* approval of investment, and the obligation to supply (which applies to some regulated suppliers).

³ Telstra Corporation Ltd (No 3) [2007] ACompT 3 at [457]

⁴ Commission (March 2014) *Further work on the cost of capital input methodologies: Process update and invitation to provide evidence on the WACC percentile*, pages 5-6.

The Commission has also invited submissions responding to points raised in its previous round of consultation.

The Commission intends to complete its review of the cost of capital input methodologies by the end of November in order for any changes to be applied to the resets of the default price-quality path for electricity distribution businesses and the individual price-quality path for Transpower. The cost of capital input methodologies for electricity distribution businesses and Transpower currently require the Commission to determine the WACC estimates used in the next resets by 1 October 2014. The following table sets out the process and indicative dates for the Commission's review:

Table 1
Indicative Timetable for Commission's Review

Process Step	Indicative Date
Notice of intention to do further work on the cost of capital IMs published	31 March 2014
Submission providing further evidence or expert reports due	1 May 2014
Draft decision on any amendments to the cost of capital IMs published	June/July 2014
Submissions on draft decision due	Early August 2014
Cross-submissions on draft decision due	Late August 2014
Final amendment to the date the WACC determinations must be published	September 2014
Final decision on any amendments to the cost of capital IMs published	November 2014

3. The Rationale for the 75th Percentile

3.1. Overview

The cost of capital incurred by regulated firms cannot be directly observed, even ex post. Therefore, there is an inherent a risk that any WACC will either over- or under- compensate businesses by an indeterminate amount. Such misspecifications in the WACC will result in social losses by virtue of establishing prices and investment incentives that deviate from the optimal levels.

If the social losses of setting the regulatory WACC either too high or too low are symmetric, then it is appropriate to set the WACC on the basis of an unbiased midpoint estimate of firms' cost of capital. However, to the extent that the social losses are asymmetric, it will be appropriate for a prudent regulator to err on the side of caution and set the regulatory WACC either:

- *higher* than an unbiased midpoint estimate (implying a higher probability of the regulatory WACC being at least as high as the cost of capital) if the social costs of setting the WACC too low are higher than those of setting it too high; or
- *lower* than an unbiased midpoint estimate (implying a higher probability of the regulatory WACC being lower than the cost of capital) if the social costs of setting the WACC too low are lower than those of setting it too high.

The Commission's approach of using the 75th percentile as the basis for its regulated WACC has generally been accepted as appropriate, given the likelihood that the costs associated with setting the WACC too low are likely to be significantly higher than those associated with setting it too high. This approach has been consistent with the advice of economic experts and with regulatory approaches in other jurisdictions. The Commission has noted:⁵

To address a number of uncertainties over the true cost of capital, the IM requires the Commission to estimate a range for the cost of capital and to use an estimate of the cost of capital above the mid-point of this range when setting price-quality paths.

That said, the lack of supporting empirical evidence for this perception prompted the High Court to question the merits of the use of the 75th percentile estimate. The Court queried whether the appropriate percentile could be identified using empirical analysis, leading to the Commission's current exercise.

In Section 5, we set out the elements that would be required in an empirical analysis. However, before considering the mechanics of such an exercise, it is useful to reiterate that there are strong, rational, reasons for setting the WACC in the upper part of an estimated range. In this section, we set out those (qualitative) reasons that form the basis for believing there to be an asymmetry in the costs associated with setting the WACC too high versus too low.

⁵ Commission (December 2010) *Input Methodologies (Electricity distribution and gas pipeline services): Reasons Paper*, paragraph 6.4.38

The social costs associated with mis-specifying the WACC fall into two broad categories, which relate to the allocative and dynamic efficiency of the industry in question:

- *allocative efficiency* – the deadweight loss associated with tariffs varying from the rates that would prevail under a correctly specified WACC; and
- *dynamic efficiency* – the losses incurred over time as a result of distorting firms' investment decisions, which can involve:
 - *in the case of setting the WACC too high*: the value of additional resources committed to 'excess' investment (offset to some extent by the additional benefits to consumers of this investment); or
 - *in the case of setting the WACC too low*: the reduction in consumer welfare associated with a lower quality or reliability of supply (offset to some extent by the savings of deferring or avoiding capital expenditure).

These issues are canvassed in sections 3.2 and 3.3. In section 3.4 we provide further support for the view that the losses are likely to be asymmetric from other jurisdictions and studies. The Commission should be reassured by the fact that the nature of this asymmetry appears to be widely supported by regulators and experts as well as supported by the (limited) empirical analysis that has been undertaken to date. Importantly, we have not found any analysis suggesting the social loss from setting the WACC too high would be more significant than that associated with setting the WACC too low.

3.2. The deadweight loss (allocative efficiency) effect

Economic theory suggests that the deadweight loss is minimised by setting prices at the level of marginal costs. The impact of variations in the WACC on the deadweight loss will therefore depend critically on the relationship between tariffs and marginal costs. The term 'marginal costs' is relatively ambiguous and there can be considerable differences between the short and long run marginal costs in an industry characterised by substantial levels of fixed assets, such as electricity lines businesses.

In the current context, it would be appropriate to consider the relationship between prices and long-run marginal costs. Without undertaking a full evaluation of the long-run marginal costs of each of the regulated companies, it is difficult to conclude that variable tariffs are either higher or lower than the relevant marginal costs.

However, as a starting premise, it seems reasonable to suggest that the tariffs that would result from setting the regulatory WACC equal to the cost of capital would minimise the deadweight loss, taking proper account of marginal costs. Under this premise, any deviations from the cost of capital, either up or down, will increase the deadweight loss.

There are sound reasons to believe that such increases in the deadweight loss are likely to be relatively small (at least in the case of prices being set above the 'optimal' level). In particular:

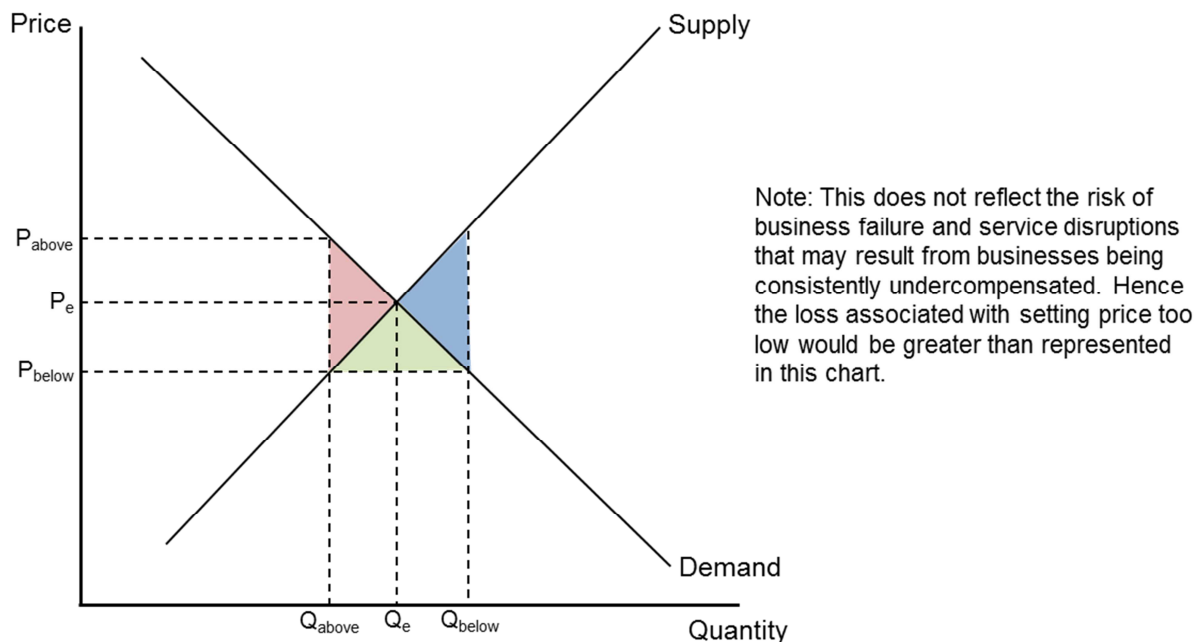
- network charges make up only a proportion of the electricity tariffs upon which consumers make their decisions; and

- electricity usage is generally considered to be relatively insensitive to retail prices, implying that movements in prices will have little impact on consumption decisions and therefore result in only small changes to the deadweight loss; and

Furthermore, in general and over relatively modest deviations of the regulatory WACC from the cost of capital, the impact on the deadweight loss from increasing or reducing prices by a similar amount could be expected to be broadly similar. This is illustrated in the following chart, where:

- the red triangle represents the deadweight loss associated with setting prices above the ‘correct’ level;
- the blue triangle represents the deadweight loss associated with setting prices below the ‘correct’ level (assuming network firms must supply the full level of demand, even if prices are below marginal costs); and
- the blue and green triangles combined represent the financial loss to regulated utilities.

Figure 1
Illustration of deadweight loss from over and under setting prices



However, the above chart does not reflect the potential risk of business failure that would be associated with consistently providing a WACC below the cost of capital. Tariffs that fall below a level sufficient to allow the full recovery of the cost of service provision (including the cost of capital) may cause financial distress to the regulated firm and ultimately cause major disruptions in services.

On balance, this suggests that the regulator may wish to err on the side of caution in setting a regulatory WACC to ensure that businesses are at least sufficiently compensated for the costs they incur.

3.3. The firms' investment decisions (dynamic efficiency)

Part 4 is intended to ensure that suppliers of regulated goods and services have incentives to innovate and to invest, including in replacing or upgrading assets. These incentives are important for ensuring the dynamic efficiency of the industry and ensuring long-term benefits to consumers. Setting the regulated return at a level commensurate with firms' cost of capital can be expected to lead to 'optimal' investment decisions, such that the marginal benefit from an additional unit of investment expenditure is equal to the marginal cost of that investment.

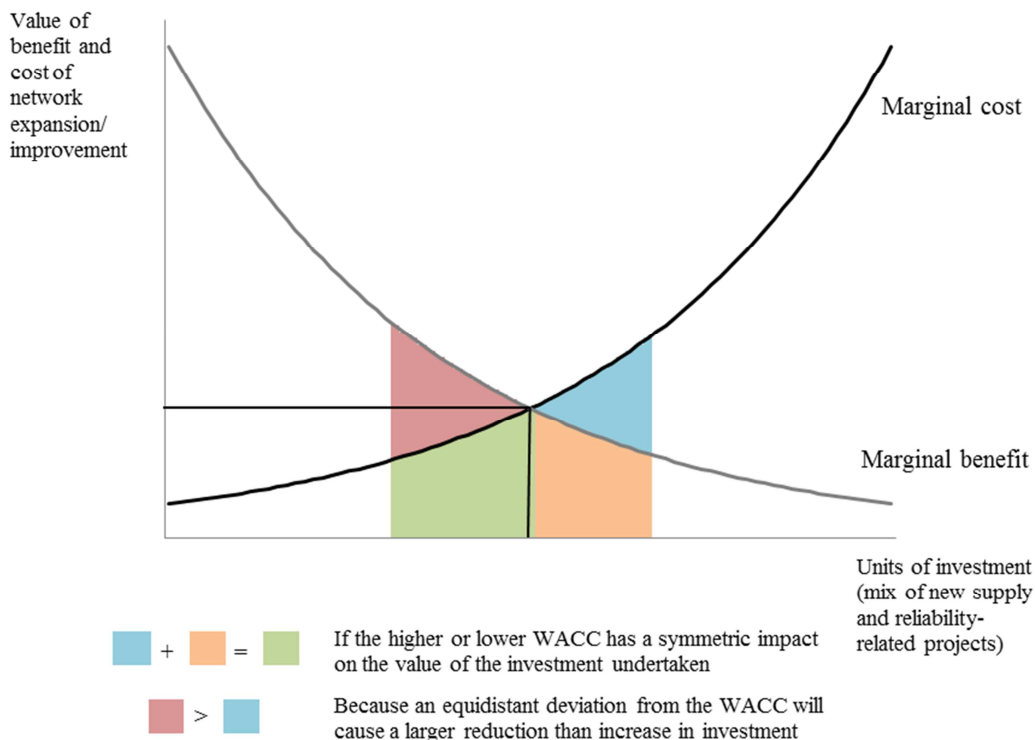
The marginal investment decisions that are most likely to be affected by the WACC (in the current context) are those that relate to reliability improvement measures and other service quality improvements. Under these conditions, the 'optimal' level of investment occurs when the additional cost associated with increasing reliability exactly equals the value of the additional benefits associated with that increase in reliability.

Setting the regulatory WACC higher (lower) than firms' cost of capital will increase (reduce) the incentive to invest, moving the industry away from the point of equilibrium and resulting in a deadweight loss.

There are two reasons for believing that setting the WACC at a level that is, for instance, one per cent higher than that cost of capital will have a lesser impact on the social loss than setting the WACC at a level that is, for instance, one per cent lower.

First, the marginal cost of investment required to improve reliability standards is likely to be upward sloping. This suggests that a dollar increase in investment is likely to result in a smaller movement away from the optimal level than a dollar decrease in investment. This is illustrated in the following diagram.

Figure 2
Illustration of the Loss Associated with Distorting Investment



Second, the regulatory framework has mechanisms in place to limit the risk of excess or wasteful capital expenditure (for example IM clause 5.2.1 provides for ex ante review of capital expenditure plans to ensure they meet the expenditure objective before such assets can be rolled into the RAB).

Although certain features of the regulatory framework also limit the risk of under investment, their impact is likely to be much weaker and relate to the issue of whether expected minimum standards are being met. This suggests that investment decisions are likely to be more sensitive to movements in the regulated WACC away from the cost of capital in a downward direction, as opposed to an upward direction.

The effect of this second factor in the illustrated example above would be to reduce the blue and orange shaded areas by reducing the increase in investment resulting from an increase in the WACC. Thus the blue deadweight loss associated with setting the regulated WACC above the cost of capital would be unequivocally smaller than the red loss associated with setting the regulated WACC below the cost of capital.

3.4. General support for the asymmetry

The above qualitative analysis outlines the rationale for the (generally held) view that the social loss associated with setting the WACC too low is likely to be more significant than that associated with setting it too high (by a corresponding extent).

This has been explicitly recognised by the Commission:⁶

In balancing the risk between setting the WACC too high or too low, the Commission assessed the consequences of possible errors. The consequences depend on the regulatory context in which the estimate of the cost of capital is being used. In some regulatory contexts a cost of capital estimate below the midpoint might be considered, in other contexts the midpoint is appropriate, in other contexts a cost of capital estimate that is above the midpoint would be appropriate.

And:⁷

The reason for the Commission adopting under Part 4 a cost of capital estimate that is above the mid-point is that it considers the costs from the point of view of consumers associated with underestimation of the cost of capital in the Part 4 regulatory setting, are likely to outweigh the short-term costs of overestimation. That is, the Commission acknowledges that where there is potentially a trade-off between dynamic efficiency (ie incentives to invest) and static allocative efficiency (ie higher short-term pricing) the Commission, under Part 4, generally favours outcomes that promote dynamic efficiency. Accordingly, this consideration has been given greater weight for price-quality regulation than minimising the costs to consumers of regulated suppliers earning excess profits through higher prices in the short-term.

Dobbs (2011) notes that the qualitative argument that the welfare impact of setting a regulated WACC too low is likely to be significantly greater than the impact of over-pricing if it is set too low has been accepted by the following regulators (in addition to the New Zealand Commission):⁸ Ofcom (UK); CAA (UK); and the Competition Commission (UK).

For example, the UK's Competition Commission in the context of its 2007 determination of regulated charges for Heathrow and Gatwick Airports stated:⁹

We believe the cost of setting a lower WACC to be higher than vice versa. If the WACC is set too low, there may be underinvestment from BAA or potentially costly financial distress. Particularly given the airport's regulatory regime it is difficult for the CAA to reduce the risks of under-investment within a regulatory period. On the other hand, if the WACC is set too high then users will pay more than they should.

The Chairman of the AER has also said:¹⁰

⁶ Commission (December 2010) *Input Methodologies (Electricity distribution and gas pipeline services): Reasons Paper*, paragraph 6.7.10, page 167.

⁷ Commission (December 2010) *Input Methodologies (Electricity distribution and gas pipeline services): Reasons Paper*, paragraph H11.62, page 570.

⁸ Dobbs, IM (2011) "Modeling welfare loss asymmetries arising from uncertainty in the regulatory cost of finance," *Journal of Regulatory Economics*, 39:1-28, page 2

⁹ Competition Commission (2007) *BAA Ltd: A report on the economic regulation of the London airport companies (Heathrow Airport Ltd and Gatwick airport Ltd)*, page 224.

...there is a need to have regard to the economic costs and risks of the potential for under and over investment by a regulated network service provider. In part, this principle relates back to the first one I have listed in that it is recognised that the economic cost of under-investment in services is greater than the economic cost of a small over-investment. This asymmetry is well understood in regulatory economics and is key to the deliberations of regulators. Again, this asymmetry is something that the AER has explicitly acknowledged and addressed as part of our rule change proposal.

In addition, in a report submitted to the Commerce Commission earlier this year, Frontier Economics found that the UK's Competition Commission also sets the WACC above the midpoint estimate:¹¹

Table 2
Summary of point estimates adopted by the UK Competition Commission

Determination	Point estimate adopted
Bristol Water (2010)	100 th percentile
Stansted Airport (2008)	81 st percentile
Heathrow Airport (2007)	88 th percentile
Gatwick Airport (2007)	85 th percentile

Note: The percentiles set out in this table are those which equate to the WACC determined by the Competition Commission. To be clear, the Commission determines the point estimate of the WACC first, and *then* determines which percentile this point estimate equates to. It does not determine the WACC from specifying some preferred percentile to adopt.

The WACC applied to airports by the UK Civil Aviation Authority (CAA) in the context of its price setting determinations, while different to those adopted by the Competition Commission, were also above the midpoint estimate. In its fifth quinquennial review of prices at Heathrow and Gatwick, which set price controls for 2008 to 2013 (later extended to 2014), the CAA set the regulated WACC for Heathrow at a value which equated to the 77th percentile, and for Gatwick at a value which equated to the 75th percentile. In its sixth quinquennial review, which set price controls for 2014 to 2018, the regulated WACC equated to the 61st percentile for Heathrow, and the 59th percentile for Gatwick.¹²

¹⁰ Reeves, A (2011) *Promoting efficient investment – protecting consumers from paying more than necessary*, AER Chairman's Address, AER Public Forum, 23 November

¹¹ Frontier (2014) *Evidence in support of setting allowed rates of return above the midpoint of the WACC range: A report prepared for Transpower New Zealand Ltd*, page iv

¹² Civil Aviation Authority UK (April 2014) *Estimating the Cost of Capital: Technical Appendix for the Economic Regulation of Heathrow and Gatwick from April 2014 – Notices Granting the Licenses*, p.45

Dobbs also notes various consultancy reports that have suggested the use of higher percentiles of the WACC distribution (even up to the 95th percentile).¹³ For example, SPG (2005) argues that:¹⁴

[W]e propose that the regulatory WACC should be set so that there is at least a 75-80% chance that it is sufficient to meet the true cost of funds. This is based on the asymmetry in the consequences of erring on this matter. If the entity fails to earn a return that is at least equal to its cost of funds, there are implications for the ongoing viability of the entity and for future investment. These consequences can be severe, given that it is essential basic infrastructure businesses that are regulated. This regulatory risk must be balanced against the prices paid by consumers. There is a trade-off between price on the one hand and service and reliable supply on the other. Setting a 75-80% probability of being able to earn a return sufficient to cover the true cost of funds is consistent with the notion that ensuring the ongoing viability of the business and creating the right incentives for future investment is more important than keeping prices to a minimum...

This qualitative view is consistent with the (few) theoretical empirical studies that have been undertaken. For example, Dobbs (2011) carries out an empirical assessment of the social loss associated with distorting investment incentives by misspecifying the WACC and concludes the following:¹⁵

[F]or sunk investment, there is little argument for up-lift in the [allowed rate of return (AROR)] whilst for both new non-deferrable and new deferrable investment, there is a strong case for uplift in the AROR. This is for two reasons: firstly, because the AROR that maximizes economic welfare is likely to be well in excess of the mean of the WACC distribution, and, secondly, because there is inevitably uncertainty over the exact location of the optimum, and the errors that arise from setting the AROR too high are much less than those associated with setting it too low.

And:¹⁶

There are two reasons for setting the AROR above the mean value of the WACC distribution – firstly, because the value that maximizes economic welfare generally lies to the right of the mean of the WACC distribution – and secondly, because expected economic welfare is an asymmetric function; given the precise value of the optimal AROR is uncertain, for each percentage point the AROR is inadvertently set above the optimum, the welfare loss is less than that which arises from setting it an equal number of percentage points too low... [T]he asymmetry in the welfare function

¹³ Dobbs, IM (2011) “Modeling welfare loss asymmetries arising from uncertainty in the regulatory cost of finance,” *Journal of Regulatory Economics*, 39:1-28, page 2

¹⁴ SPG (2005) *A Framework for Quantifying Estimation Error in Regulatory WACC: A Report for Western Power in relation to the Economic Regulation Authority’s 2005 Network Access Review*, page 30

¹⁵ Dobbs, IM (2011) “Modeling welfare loss asymmetries arising from uncertainty in the regulatory cost of finance,” *Journal of Regulatory Economics*, 39:1-28, page 2

¹⁶ Dobbs (2011), page 26

for new investment (vis a vis that for sunk investment) is so strong that even if the proportions of potential new investment are quite small, this can still induce a significant uplift in the optimal choice for the AROR compared to the WACC mean.

That this view is generally held and supported by the (albeit limited) empirical studies that have been undertaken, should provide reassurance to the Commission that its approach of using the 75th percentile WACC estimate is reasonable. It is also important to note that we have not found any support for the opposite view, that the social loss of providing a WACC that is too low would be less than that of providing a WACC that is too high.

4. The Commission's estimated WACC

The previous section considered the relationship between the regulated WACC and an unbiased estimate of firms' cost of capital. The discussion in that section focused on positioning a regulated WACC relative to the expected value of the cost of capital, given uncertainties. On the basis of that qualitative analysis, we concluded that a prudent regulator may wish to set the WACC such that it is more likely to over- rather than under- compensate firms.

However, this is not precisely the same as suggesting the Commission should set the WACC at a level higher than its midpoint estimate. It is also necessary to consider the nature of the Commission's methodology and whether this is likely to result in midpoint estimates that are higher or lower than unbiased estimates of the cost of capital. For example, if the Commission's methodology is downwardly biased, the use of its midpoint estimate would imply that a regulated firm would be less than 50% likely to recover its full cost of capital.

The probability of the Commission's methodology resulting in an unbiased estimate depends on both the choice of models and the statistical error surrounding individual parameter estimates.¹⁷ In line with this, the Commission sets out its rationale for setting regulated quality-price paths using the 75th percentile of the WACC range estimate in its December 2010 *Input Methodologies (Electricity Distribution and Gas Pipeline Service): Reasons Paper*.¹⁸ The Commission stated that its choice of the 75th percentile was informed by a number of considerations, such as:

- the Part 4 Purpose is to promote the long-term benefit of consumers, including:
 - ensuring suppliers of regulated services have incentives to invest and innovate (s.52A(1)(a)) and the potential long-term benefits to consumers from investment and innovation;
 - ensuring regulated suppliers are limited in their ability to extract excessive profits (s.52A(1)(d));
- the risk that the true (but unobservable) WACC is above the estimated mid-point WACC;
- the risk that CAPM and the simplified Brennan-Lally CAPM may under-estimate the returns on low beta stocks;
- the risk that the simplified Brennan-Lally CAPM may lead to higher estimates of the cost of capital than the International CAPM would for international investors, and that international investors are likely to be the marginal investors in the New Zealand market; and
- the risk of error in estimating individual parameters of the simplified Brennan-Lally CAPM including the asset beta and the TAMRP.

This demonstrates that the choice of the 75th percentile had two purposes:

¹⁷ Op cite, paragraph H11.5, page 558.

¹⁸ Pages 167-168

- to adjust for any bias inherent in the Commission's methodology; and
- to ensure that, on balance, the WACC is more likely to be at least as high (rather than below) the true cost of capital.

The rationale for ensuring that the WACC is more likely to be at least as high as the cost of capital was discussed in Chapter 3. In this Chapter we consider the bias inherent in the Commission's IM methodology.

There are three aspects of the Commission's methodology that suggest its midpoint estimate is likely to underestimate firms' required returns:

- the Capital Asset Pricing Model (CAPM) has been shown to provide biased results for firms with betas that differ significantly from one. A recent study in the US has suggested that the bias may result in the cost of equity for energy utilities being underestimated by 400 basis points;¹⁹
- the IMs do not compensate firms for the asymmetric risks associated with the distribution of returns being truncated on the upside without an offsetting downside truncation. Regulation prevents returns from reaching excessive levels while leaving firms exposed to the risks associated with such events as natural disasters and asset stranding; and
- the use of the five year debt term introduces an inconsistency in the approach to estimating the costs of equity and debt, resulting in a downward bias.

Although these points have been well documented and evidenced throughout various regulatory consultations, we provide a brief summary of the compelling evidence below.

4.1. CAPM provides inherently downwardly biased results

The Commission's WACC estimate is based on the Capital Asset Pricing Model (CAPM) approach to estimating the cost of equity. This framework has been shown, in a number of studies, to provide a relatively inaccurate measure of the cost of equity. Many studies have found that estimates of the cost of equity derived from the CAPM do not closely match observed returns. In a review of numerous empirical studies, Fama and French (2004) conclude that:²⁰

In the end, we argue that whether the model's problems reflect weakness in the theory or in its empirical implementation, the failure of the CAPM in empirical tests implies that most applications of the model are invalid.

¹⁹ Chrétien, Stéphane and Coggins, Frank (2011) "Cost of Equity for Energy Utilities: Beyond the CAPM," *Energy Studies Review*: Vol. 18: Iss. 2, Article 2, abstract.

²⁰ Eugene Fama and Kenneth French (2004) "The Capital Asset Pricing Model: Theory and Evidence," *Journal of Economic Perspectives*, vol 18, no 3, Summer 2004, page 47.

Specifically, the CAPM has been shown to provide biased results for firms with betas that differ significantly from one. In a 2013 paper, Villadsen, Carpenter, Vilbert, Brown and Kumar note:²¹

Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) Identified a fundamental challenge to the CAPM; namely that low-beta stocks have higher average returns than predicted by the CAPM, and high-beta stocks lower average returns... This suggests that the cost of capital for regulated companies, which often have a beta less than one, will be underestimated by the traditional CAPM.

In a 2011 review of the cost of equity for energy utilities, Chretien and Coggins conclude:²²

The Capital Asset Pricing Model (CAPM) is applied in regulatory cases to estimate the required rate of return, or cost of equity, for low-beta, value-style energy utilities, despite the model's well documented mispricing of investments with similar characteristics. This paper examines CAPM-based estimates for a sample of American and Canadian energy utilities to assess the risk premium error. We find that the CAPM significantly underestimates the risk premium for energy utilities compared to its historical value by an annualized average of more than 4%.

Similar results were obtained by Hird, Grundy and Young in their 2008 study of Australian returns:²³

... we have replicated the Fama and Macbeth study using 44 years of monthly Australian return data from 1964 to 2007. We also find the same results as other researchers... the estimated sensitivity of market returns to beta (the slope of the average returns predicted by the data) is much lower than predicted by the Sharpe CAPM (and is not statistically significantly different from zero).

4.2. No compensation elsewhere in the IMs for the asymmetric distribution of returns

A firm faces asymmetric risk when its distribution of returns is truncated at one extreme without an offsetting truncation at the other. In regulated industries, regulation can cap potential profits without providing commensurate insulation from downside risk. Downside risks can include the risk of natural disasters, such as the Christchurch earthquake, terrorist attacks, pandemics, asset stranding risk, and the like.

Asymmetry in the distribution of potential returns is not compensated for within the IM framework. This has been recognised by the Commission:²⁴

²¹ See Villadsen, Carpenter, Vilbert, Brown and Kumar (2013) *Estimating the Cost of Equity for Regulated Companies*, The Brattle Group, prepared for the Australian Pipeline Industry Association, page 15

²² Chrétien, Stéphane and Coggins, Frank (2011) "Cost of Equity for Energy Utilities: Beyond the CAPM," *Energy Studies Review*: Vol. 18: Iss. 2, Article 2, abstract.

²³ Dr Tom Hird, Professor Bruce Grundy and Daniel Young, (2008) *Estimation of, and correction for, biases inherent in the Sharpe CAPM formula: A report for the Energy Networks Association, Grid Australia and APIA*, CEG

The IMs do not make any adjustments to the cost of capital for asymmetric risk.

These risks are cash-flow related and the Commission considers it appropriate to address them through cash-flow adjustments rather than an adjustment to the WACC. In its *Reasons Paper*,²⁵ the Commission states that setting the WACC at the 75th percentile is not intended to compensate businesses for these risks. The Commission's reasoning was that an ad-hoc adjustment to the service-wide cost of capital would imply that all suppliers of a particular service are exposed to the same level of asymmetric risk, which is unlikely to be the case.

However, to date, businesses have not been compensated for these risks through their cash-flows. The Commission has stated:

- Type I risks include those that are generally unrelated to the day-to-day operations of the firm, such as natural disasters, pandemics, terrorist threats or large unexpected policy shifts. The Commission does not believe it is appropriate to compensate for these through uplift in the WACC but recognises that they are not currently compensated for elsewhere in the regulatory framework.
- Type II risks include those which relate to the competitive environment, such as the threat of competitive entry or expansion and stranding risk. The Commission has not been convinced that such risks exist in the case of EDBs/GPBs and Transpower. The IM therefore does not make an allowance for these items but the Commission notes that they could be demonstrated in a CPP application.

However, in the absence of having quantified the appropriate adjustment, there is currently no explicit compensation for these risks within the IM framework. Given this, setting the allowable return above the midpoint WACC to some extent compensates for these risks. This point is raised by Professor Grundy in his paper earlier this year:²⁶

When a regulator's estimate of future profits assigns no probability to stranding risk, the regulator's estimate of future profits overstates the true expected profit and a regulated business cannot expect to earn a normal return unless the regulatory building blocks somehow compensate for that risk elsewhere. One way of doing so is to set the allowed rate of return above the cost of capital.

A second such risk arises whenever a regulated entity faces the risk of a natural disaster (eg and earthquake) that is not recognized in the regulator's estimate of future profits. Again, the regulator's overestimate of future profits can be offset by an adjustment that sets the allowed rate of return above the cost of capital.

²⁴ Commission (December 2010) *Input Methodologies (Electricity distribution and gas pipeline services): Reasons Paper*, paragraph H12.2, page 571.

²⁵ See the discussion in "H12 Possible Adjustments to the Cost of Capital for Asymmetric Risk", pages 571-578.

²⁶ Bruce Grundy (March 2014) *The Logic and Economics Underlying the use of a 75% Rule in a Regulatory Environment*, page 2.

The Commission has also recognised this in the context of its consideration of Orion's CPP:²⁷

[A]lthough the IMs do not make any explicit adjustments to the cost of capital (or provide additional cash-flow allowance) for asymmetric risk, the practical effect of using the 75th percentile WACC is to provide a buffer for catastrophic events.

4.3. Use of a five year debt term introduces an inconsistency and results in a downward bias

In its input methodologies, the Commission has argued that to ensure the cost of capital is consistent with the period of application of the regulatory instrument in which it will be applied, the term of the risk-free rate must be the same as the regulatory period.²⁸ For most applications, this means a term of five years, though a three year or four year term will be required where a CPP applicant seeks a three or four year CPP.

As noted by the Commission, the risk-free rate may either increase with term or decrease with term depending on the nature of the yield curve facing the market. In particular:

- under an inverse yield curve, the risk-free rate will decline with term; and
- under a positive yield curve, the risk-free rate will increase with term.

The Commission argued that setting the risk-free rate to a term longer (or shorter) than the regulatory period may provide gains or losses depending on the term structure of interest rates. The Commission argued that, under a positive yield curve (which New Zealand currently has) a risk-free rate with a term longer than the regulator period would mean that suppliers would be compensated for risks they do not bear. Conversely, the Commission notes that if there was an inverse yield curve, then regulated suppliers would be under-compensated if the term of the risk-free rate was longer than the regulatory period.

However, the Commission's approach is questionable and a number of suppliers have expressed their disagreement with setting the term of the risk-free rate to match the regulatory period. These parties argued that the risk-free rate with the longest maturities available in New Zealand (ie, 10 years) should be used. In support of this, the suppliers argued that:²⁹

- regulated supplier's assets had a long life and firms generally seek to finance such assets with longer maturity debt (that is, longer than the regulatory period); and
- some firms have issued a portion of their debt with a maturity exceeding five years to manage their re-financing risks.

Importantly, the Commission's approach of using a five year (or shorter) risk free rate introduces an inherent inconsistency in its WACC approach. This arises as a result of the

²⁷ Commission (2013) *Setting the customised price-quality path for Orion New Zealand Limited: Final reasons paper*, page 142

²⁸ Commerce Commission, *Input Methodologies (EDBs & GPBs) – Reasons Paper*, 22 December 2010, p.138.

²⁹ Commerce Commission, *Input Methodologies (EDBs & GPBs) – Reasons Paper*, 22 December 2010, p.138.

Commission using cost of equity and cost of debt estimates that are based on different financing arrangements.

When firms borrow over longer time frames, a portion of risk is transferred from equity to debt holders. Borrowing over shorter time horizons therefore involves increasing the risk to equity holders. It is inconsistent for the Commission to base the cost of equity on the costs of firms with longer debt structures and then combine this with the cost of shorter-term debt. Such an approach consistently under-estimates firms total cost of capital. This issue was well described in Grundy (2010).³⁰

The Commission's methodology provides an opportunity for businesses with longer debt terms to have their cost of debt estimate modified accordingly. While this improves the estimated WACC for those firms, it does not address the fundamental inconsistency in the approach, which results in firms with relatively short debt terms having a mismatch between the basis for the costs of equity and debt. Overall, this results in a further downward bias in the Commission's WACC estimates.

4.4. Approaches in other jurisdictions

The focus of the Commission's regulatory role is on the overall rate of return to the businesses. This is consistent with the 'end result' doctrine that was developed in US case law in the *Hope* case and which was subsequently embraced by US regulators:³¹

It is the result reached and the impact of the rate order rather than the method or theory employed that is controlling. Potential infirmities inherent in the methods used are of secondary importance, according to this doctrine. This is a reassuring assertion, given the stringency and surrealism of the assumptions that frequently characterize the financial models and theories employed in the determinations of a fair return.

Similarly, we note that in Australia, the provisions for appealing regulatory decisions in the electricity and gas sector have recently been modified to ensure that the Competition Tribunal gives primary consideration to the reasonableness of the whole decision.³²

This suggests that if certain components of the methodology result in a risk of under-compensating businesses then it is imperative that other aspects offset this. On this basis, it would be inappropriate to consider whether the WACC should be set above or below the Commission's midpoint estimate without taking account of any bias inherent in that midpoint estimate.

The above discussion reiterates the concerns and evidence raised extensively throughout previous consultation rounds that strongly suggest the Commission's methodology results in downwardly biased midpoint estimates. In assessing the merits of using the 75th percentile

³⁰ Bruce Grundy (August 2010) *The Calculation of the Cost of Capital: A report for Vector*

³¹ Morin, R (2006) *New Regulatory Finance*, Public Utilities Reports, Inc., Vienna, Virginia, p.14.

³² See: Standing Council on Energy and Resources, *Regulation Impact Statement – Limited Merits Review of Decision-Making in the Electricity and Gas Regulatory Frameworks: Decision Paper*, 6 June 2013.

estimate, it is necessary to be mindful of the fact that setting the regulated WACC above the Commission's midpoint is, at least in part, intended to offset this inherent bias.

It is useful to note that it is not unusual for regulators to choose to set the regulatory WACC at a level other than a midpoint estimate for a range of reasons. For example, in the context of its review of the methodology for determining the WACC, IPART reviewed the practices of a number of regulators and found the following:³³

³³ IPART (December 2012) *Review of method for determining the WACC: Dealing with uncertainty and changing market conditions: Other Industries – Discussion Paper*, page 74

Table 3
Summary of regulatory approaches for setting WACC

Regulator	Approach for WACC inputs	Midpoint or other
IPART (Australia)	Range	Discretion exercised. Recent determinations at the upper end of the range to reflect market conditions.
AER (Australia)	Point estimate	n/a
ERA (Australia)	Point estimate	n/a
QCA (Australia)	Point estimate	n/a
ESC (Australia)	Range	Discretion exercised. Latest decision at upper end of the range to reflect market conditions so businesses can recover actual borrowing costs and likely future borrowing costs.
ESCOSA (Australia)	Point estimate	n/a
Ofgem (UK)	Range for the cost of equity inputs	Discretion exercised. Latest decision uses CoE parameters at the upper end of the range. Focuses on longer-term estimates given the 8-year regulatory period.
Ofwat (UK)	Range	Discretion exercised. Latest decision set WACC above midpoint range in view of financial market conditions and uncertainties.
NZCC (NZ)	Range	Use of 75 th percentile WACC due to the social cost of setting a rate that is too low.
NMa (Netherlands)	Range	In principle, midpoint is used unless there are reasons not to.

In a 2006 report, PWC identified the following premiums applied to the WACC by regulators:³⁴

³⁴ PWC (2006) *TenneT TSO Comparison study of the WACC: Final Report*

Table 4
Additional Premiums

Regulator/date	Reasons given for premium	Premium to the WACC
CREG (2004)	Illiquidity of non-listed companies	20% additional return on the cost of equity
Ofwat (2004)	Higher equity trading costs Costs of raising debt and equity capital	0.3%-0.9% premium on the post-tax WACC
Ofgem (2002)	Relative small company size Cross-reference to 2000 Competition Commission decision	0.8% premium on post-tax cost of equity
Oftel (2002)	Oftel suggested a small firm premium for mobile service providers, no specific reason provided	1.35% premium on post-tax cost of equity
Competition Commission (2000)	Impact of lower trading liquidity on cost of equity Market evidence on the impact of company size on the cost of debt	1% premium on post-tax cost of equity Cost of debt 0.9% higher for small companies
Ofwat (1999)	More limited access to capital markets Lower liquidity Higher issue costs	0.4% to 0.75% premium on post-tax WACC

There are also examples of regulators choosing parameter values towards the upper end of estimated ranges, which has a similar effect to selecting a WACC above a midpoint estimate.

For example, the AER estimated an equity beta range of 0.4 to 0.7 and then selected a point estimate at the top of this range, noting the following:³⁵

We consider the evidence currently before us is sufficiently strong to justify applying an equity beta point estimate at the upper end of the 0.4 to 0.7 range of empirical estimates. Adopting a point estimate around the mid-point would be more reasonable if our intention was to base the allowed return on equity on the Sharpe-Lintner CAPM and empirical estimates alone. However, the rules require us to have regard to relevant estimation method, financial models, market data and other evidence when determining the allowed rate of return. When this information is taken into account, we consider it reasonable to select a point estimate from the upper end of the range of empirical equity beta estimates.

³⁵ AER (2013) *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, page 76-77

Similarly, Ofwat adopt an equity beta of 0.9, which was the upper point of the range of 0.5 to 0.9, which was estimated by its consultants³⁶ and, in its most recent pricing determinations for Heathrow and Gatwick, the CAA adopted betas that were at the upper end of its assumed range.

Table 5
Betas adopted by the UK CAA³⁷

	Range	Point Estimate
Heathrow	0.90 – 1.15	1.10
Gatwick	0.90 – 1.17	1.13

³⁶ Ofwat (2009) *Future water and sewerage charges 2010-15: Final Determinations*, pages 127-128.

³⁷ UK Civil Aviation Authority, *Estimating the Cost of Capital – Technical Appendix for the Economic Regulation of Heathrow and Gatwick from April 2014: Notices Granting the Licenses*, February 2014, p.44.

5. Determining the “Optimal” Percentile

5.1. Introduction

In its decision, the High Court noted that there was insufficient analysis or empirical evidence to justify the Commission’s choice of the 75th percentile WACC. The Court also referred to the use of a loss function to determine the appropriate WACC percentile, as was discussed at the Cost of Capital Workshop.

The discussion regarding the use of a loss function at that workshop was relatively high-level. The key elements of the discussion are summarised as follows:

Professor van Zijl noted that:³⁸

...the Commission also needs to give some thought as to why would you select the 75th percentile or the 90th percentile or the 60th percentile or whatever. Clearly that must relate to the cost of being wrong in the sense of being too low versus the cost of being wrong in the sense of being too high. So in other words there must be some sort of loss function that would lead you to pick the 75th percentile as opposed to some other point on that distribution.

Now clearly there are different kinds of loss functions that one could postulate but a simple linear loss function would, for example, say that the cost of being too low is three times the cost of being too high, which is equivalent to a 75th percentile. If it was 90% the ratio would be 6. At least by thinking about it in that way you’ll have a more logical basis for choosing a particular percentile as opposed to some other percentile.

In response, Mr Balchin raised the concern that, in practice, such an exercise is likely to be difficult:³⁹

Measuring, actually trying to measure the degree of asymmetry in this loss function is very difficult. I’ve never seen a study that’s actually tried to do it and I can’t actually think of an easy way to do it...And even implementing, trying to get a handle on the probability distribution of a WACC, as Martin has done, on the assumption that the CAPM holds is quite difficult.

In response to the questions raised around the potential to apply a loss function analysis in this way, the Commission has invited submissions providing:⁴⁰

[E]mpirical or analytical evidence regarding the appropriate WACC percentile. For example, the Court referred to the possibility of using a ‘loss function’ approach which

³⁸ Cost of Capital Workshop Day 2 Transcript (November 2009), page 211

³⁹ Cost of Capital Workshop Day 2 Transcript (November 2009), page 214

⁴⁰ Commission (March 2014) *Further work on the cost of capital input methodologies: Process update and invitation to provide evidence on the WACC percentile*, pages 5-6.

would estimate the relative social harm done by over-estimating and under-estimating the WACC, to determine the appropriate percentile.

However, in framing its request in this way and in light of the timeframe allowed for submissions, there is a risk the Commission has substantively underestimated the degree of complexity, uncertainty and informational intensity such analysis will necessarily involve in order for it to be meaningful and informative. In addition, any such analysis is likely to be highly controversial.

There is virtually no guidance in the economic literature or the practices of other regulators regarding the application of loss functions to this particular issue. The most informative theoretical paper on this subject that we have found is Dobbs (2011). However, we note that applying this theoretical approach to a real-world situation will not be straightforward. The structure of the model and its applicability to the network businesses would need to be carefully considered. Furthermore, the results depend critically on a number of underlying parameters and assumptions, each of which would no doubt be the subject of considerable divergence of opinion between various stakeholders.

To the best of our knowledge, no regulator in New Zealand, Australia or anywhere else in the world has attempted to quantify the likely changes in social welfare from either over-estimating or under-estimating the cost of capital. The Commission and relevant stakeholders would essentially be embarking on this task with a blank sheet.

In our opinion, the timeframe for submissions is insufficient to allow the preparation of plausible estimate of the net social costs. Rather than attempting to do so, we have therefore set out our understanding of the type of framework by which such net social costs could be identified and assessed.

Determining the appropriate WACC percentile using the type of analysis envisaged would essentially involve three steps:

1. identifying the social loss (which in itself balances costs and benefits) associated with setting the regulatory WACC at varying levels above or below the cost of capital;
2. determining the distribution function for the cost of capital (which may differ from that of the regulatory WACC estimates, depending on any inherent bias in the Commission's framework); and
3. combining these two functions to determine the appropriate percentile within the Commission's estimated WACC range.

We elaborate on the requirements and complexities of each of these steps in the following sections.

Alternatively, the Commission (or other interested parties) may wish to undertake a modelling exercise similar to that set out in Dobbs (2011). However, testing the applicability of that specific model to a real-world example will be an exercise in itself, whereas the framework we set out below is potentially more general in application. Furthermore, an empirical modelling exercise will need to carefully consider the value and distribution of the parameters involved, which include:

- marginal costs;

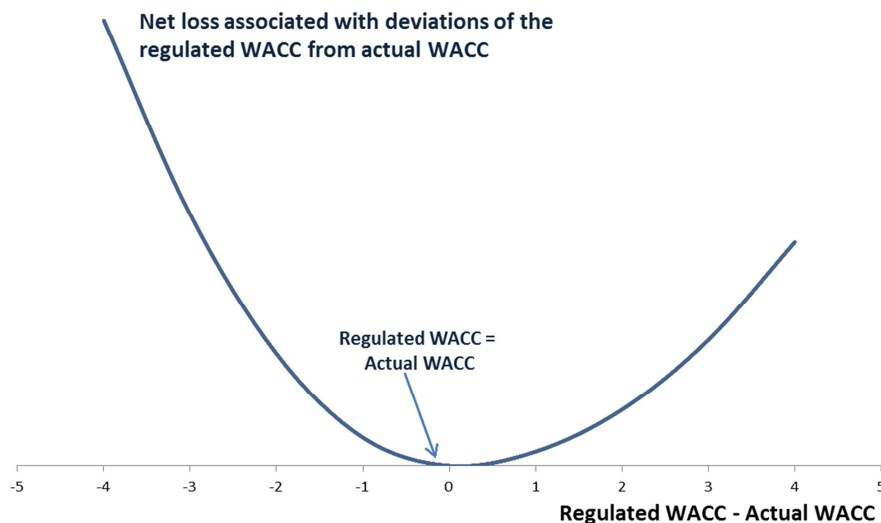
- capital costs;
- depreciation;
- demand growth;
- demand elasticity;
- the regulatory review period;
- the proportion of deferrable new investment to total investment; and
- the optimal allowed rate of return (which Dobbs demonstrates to be above the midpoint estimate).

This type of analysis will provide a range of potential optimal percentiles. For example, over the range of parameter values Dobbs tests, the optimal percentile varies from the 48th to the 90th. While it would be possible to narrow this range considerably in the case of suitable parameters for the network industries, it is highly likely that there will remain a significant range for the estimated optimal WACC.

5.2. Identifying the social losses

The discussion to date regarding the use of a loss function has been relatively simplistic, suggesting that if the loss associated with providing regulated entities with a return below the true WACC was three times that associated with providing a return above the true WACC, then the 75th percentile is the appropriate point estimate. In practice, determining the relative loss associated with setting the regulatory WACC either too high or too low will be far more complex and it is unlikely such a relationship will be linear in nature. For example, the loss function may look something like the following:

Figure 3
Illustrative Example of Potential Loss Function



Identifying the social loss relationship is likely to require at least the following stages:

- the development of a framework for assessing the nature and magnitude of the social costs and benefits, which will involve specifying
 - which costs should be included;
 - which benefits should be included;
 - how these will be measured; and
 - how non-financial costs and benefits will be translated into comparable financial terms;
- the collation of the required data and other information, which may involve:
 - the provision of additional pre-existing information and data from businesses and user groups; and
 - the generation of new data by businesses and user groups;
- based on the framework and data, the identification of the social loss for:
 - each individual business, as the loss function is likely to be quite different for individual businesses depending on such factors as the state of existing infrastructure, the anticipated growth in demand, the nature of the customer base, etc;
 - various levels of over and under setting the regulatory WACC, as the implications of deviating from the cost of capital by 1 per cent are likely to be very different from the implications of deviating by 5 per cent (and this relationship is unlikely to be linear); and

- each point in time, as the social loss function may vary from year to year depending on the anticipated demand and investment path during a regulatory period.

Even with a rigorously specified framework for determining the loss function, there will be considerable risk around the accuracy of any estimate. This risk will arise from a number of factors, including:

- uncertainty regarding the implications of the WACC on businesses behaviour, given the range of other instruments used to monitor and regulate these industries (such as the investment approval framework) and the nature of the regulatory regime (ie, ID, DPP, CPP);
- the inherent uncertainty in predicting the value of unobservable costs and benefits resulting from any changes in businesses behaviour; and
- an inability to independently confirm the cost and benefit assessments proposed by various stakeholders.

For instance, the social loss associated with providing a regulated WACC above firms' cost of capital will involve assessing the implications on the behaviour of regulated entities and then estimating and balancing the following costs and benefits:

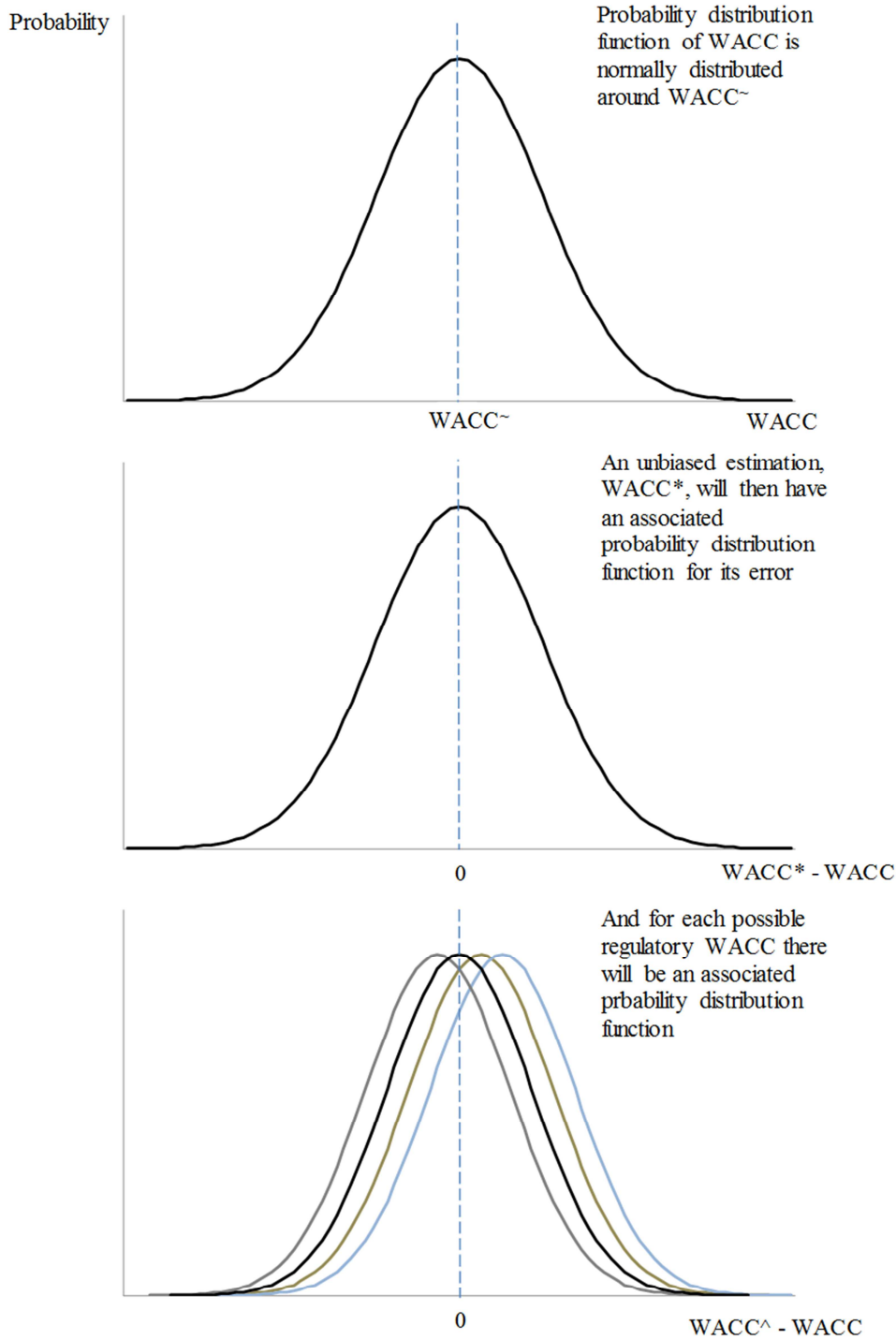
- the direct cost of any investment that would otherwise not be considered (even in the future);
- the direct costs of bringing forward any investment that might otherwise be undertaken at a later date;
- the value of the benefits associated with an increased capital expenditure plan, such as the value to consumers of increased reliability; and
- the deadweight loss associated with prices being higher than would otherwise be the case.

The complexity of this issue suggests that before seeking estimates of the social loss, it will be useful to clarify precisely which costs and benefits the Commission envisages being included in such analysis and how these are expected to be quantified.

5.3. Identifying the distribution function for the WACC

Using the loss function approach to assess the optimal WACC percentile involves finding that percentile at which the anticipated loss would be minimised, given the unknown nature of the cost of capital and therefore its probability distribution. This can then be used to estimate the probability function for deviations between the estimated WACC and the cost of capital for each WACC estimate. This is depicted in the chart below.

Figure 4
Illustrative probability distributions



Since there are various approaches for determining the cost of capital range, it is likely to be difficult to assess the appropriateness of the shape of the probability distribution curve or the standard deviation. This issue has been discussed in some detail in Tony van Zijl's 2007 submission to the Commerce Commission.⁴¹

However, as discussed in Chapter 4, there is relatively well-documented evidence to suggest the Commission's methodology provides a biased estimate of the cost of capital. At the very least there should be an explicit adjustment to the probability function to account for the risk of such bias.

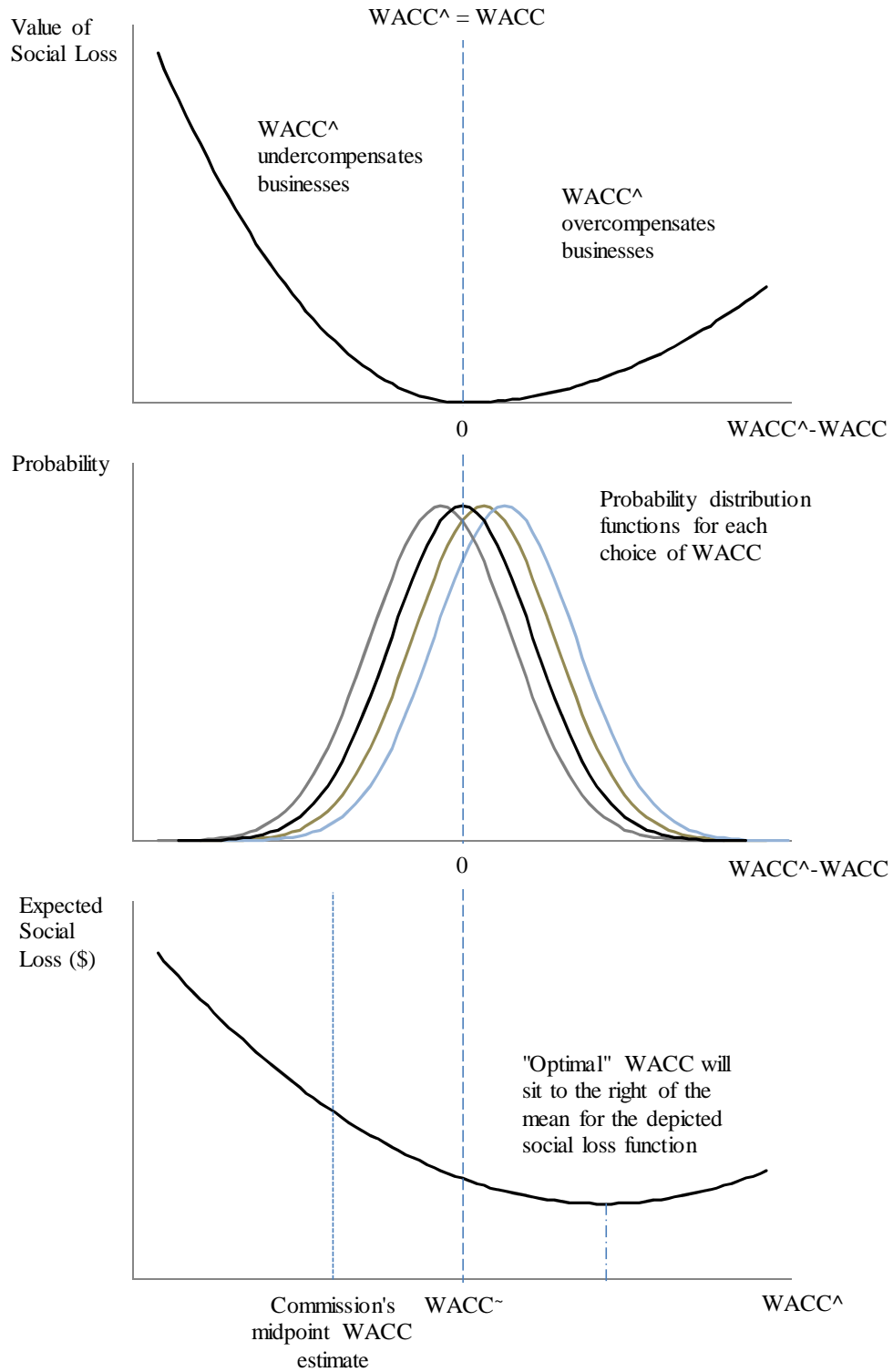
5.4. Identifying the optimal percentile

Once the social loss and probability distribution functions have been identified, the task is to identify the point estimate of the WACC that minimises the expected social loss. This is unlikely to be able to be achieved arithmetically, as it would essentially involve multiplying the estimated loss by the associated probability. Rather, a repeated sampling approach (or Monte Carlo simulation exercise) could be used to identify the WACC percentile that would minimise the social loss.

This is illustrated diagrammatically in the following chart. Intuitively, as raised in the Cost of Capital Workshop, if the loss function is symmetrical and the cost of capital is symmetrically distributed around its mid-point estimate, the optimal percentile would be the 50th. However, the nature of any asymmetry in the loss function, combined with any biases in the Commission's methodology, will drive the optimal point estimate away from the midpoint value. To the extent that the underlying parameters that determine the loss function and cost of capital probability distribution vary between firms and industries, there will be a number of identified optimal percentiles.

⁴¹ Tony van Zijl (2007) *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*, section 4: Parameter error

Figure 5
Applying the loss function and probability distribution



The perceived rigour of undertaking an empirical evaluation of the optimal percentile should not detract from the fact that any such analysis will remain heavily reliant on a range of estimates and assumptions. Given the likely uncertainty in these parameters there is a very real risk that the results of any such analysis will suggest a wide range for the optimal WACC percentile.

5.5. Conclusions

By considering the use of empirical analysis to assist it in identifying the optimal percentile for establishing the regulatory WACC the Commission is essentially embarking on a process that, to our knowledge, no regulator has previously attempted.

Achieving a defensible and broadly accepted 'optimal' WACC estimate is likely to be a complex and controversial task. In our view, the timeline contemplated in the 'notice of intention' is extremely ambitious and is unlikely to provide sufficient time to:

- develop a framework for analysing the issues;
- identify the relevant data and postulate assumptions; and
- undertake the analysis in a transparent and rigorous manner.

A more useful objective within the timeframe set may be to explore the envisaged framework with a view to identifying:

- the range of benefits and costs to be included in the analysis;
- the availability of information regarding how these costs and benefits would be affected by deviations between the regulatory and actual WACCs; and
- the degree of confidence the Commission expects to be able to achieve through such analysis.

Furthermore, the Commission must be mindful that no (reasonable) empirical analysis will be able to arrive at a definitive point estimate of the optimal percentile for a single firm, let alone an industry. The likely benefits of undertaking such a task should, therefore, be carefully considered.

At the same time, the Commission should be aware that embarking on such a process outside the context of a full review of the WACC methodology and wider IM framework, risks increasing the perceived regulatory risk associated with New Zealand's Part 4 regime. This is likely to be particularly the case if the Commission attempts to undertake the analysis and consultation within a framework that is insufficient for full consideration of the relevant issues. Such an outcome would result in an inadvertent increase in businesses' cost of capital.

6. Conclusion

The Commission's current review of the appropriateness of setting the WACC at the 75th percentile of its estimate range was, at least in part, prompted by the High Court's concern that there has been limited empirical support for the use of this particular percentile. The High Court's discussion focused on the use of the 75th percentile as a way of addressing the risk of asymmetry in the social losses associated with setting the WACC too high versus too low. The Court was concerned that this asymmetry may not hold and that there may be little basis, then, for selecting the 75th percentile rather than the 50th percentile.

Although there is limited empirical analysis to support the use of the 75th percentile, there are strong economic reasons for believing this asymmetry holds. This view is generally supported by regulators and experts. Furthermore, those empirical studies that have been undertaken do find support for using a WACC higher than an (unbiased) midpoint estimate.

However, it is critical to bear in mind that the rationale behind using the 75th percentile is much wider than solely addressing this asymmetry in social losses. In fact, the use of the 75th percentile is linked to the wider WACC methodology and IM framework and is a key element to ensuring that businesses are sufficiently compensated for their costs.

These wider reasons for the use of the 75th percentile include:

- the need to offset the risk that the Commission's WACC methodology under-estimates firms' cost of capital; and
- the need to compensate firms for the asymmetric distribution of returns, given that regulation effectively truncates the possible returns in the upward direction without providing commensurate insulation from downside risk.

Furthermore, we understand that most of the businesses regulated under Part 4 do not seek to recover their full revenue allowance. The potential for error in forecasting demand estimates or pass-through costs, along with the costs associated with over-recovery, lead firms to choose to allow a 'buffer'. In Powerco's case, we understand this has resulted in a revenue shortfall of around 0.05 per cent. This suggests that, in order for businesses to be fully compensated for costs, the Commission should add a comparable buffer margin to the revenue allowance.

For these reasons, the use of the 75th percentile must be considered within the context of not only the WACC methodology but also the wider regulatory framework. The use of the 75th percentile helps offset a number of features of the regulatory framework that might otherwise see firms consistently under-recover their costs. Such an outcome would be unsustainable in the longer term and would risk significantly distorting investment incentives.

It is therefore inappropriate to review this aspect of the Commission's WACC methodology in isolation. If the use of the 75th percentile is altered on the basis of empirical analysis that is narrowly focused on the asymmetric losses associated with setting the WACC higher or lower than the cost of capital, the Commission would be remiss if it did not then revisit the wider WACC methodology. At the same time, the Commission must be mindful of the fact that embarking on such a process outside the context of a full review of the WACC methodology and wider IM framework, risks increasing the perceived regulatory risk

associated with New Zealand's Part 4 regime. This is likely to be particularly the case if the Commission attempts to undertake the analysis and consultation within a framework that is insufficient for full consideration of the relevant issues. Such an outcome could result in an inadvertent increase in businesses' cost of capital.

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