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# Estimating WACC for Airports in New Zealand

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# Executive Summary

In its determinations on cost of capital input methodologies, the Commerce Commission set out a method by which a range of WACC estimates would be constructed and advised how particular values or "percentiles" would be selected from this range. In the case of energy networks subject to price-quality path regulation the Commission advocated using the 75th percentile, while for airports subject to information disclosure regulation it considered that the 25th and 75th percentiles should be disclosed and that the 50th percentile was a reasonable starting point for assessing profit.

In its Judgement on appeals against the input methodologies, the High Court questioned the use of the 75th percentile, noting in particular that there was no hard evidence available to support this choice. The court also advanced several arguments in favour of the 50th percentile, though it noted that the evidentiary status of those arguments was similarly lacking.

The Commission has now invited submissions on this matter. This submission was requested by BARNZ, though it reflects the independent analysis and views of the author.

***Customer welfare is the objective***

The starting point for analysis is to recognise that regulation under Part 4 of the Commerce Act is undertaken for the long-term benefit of the *customers* of regulated firms. The interests of the regulated firms are only relevant because and to the extent that customers attach value to the regulated services they supply.

***50th percentile would have survived appeal***

The reason the Court dismissed an appeal for using the 50th percentile is that it lacked supporting evidence. However the Court made it clear that there was a similar lack of evidence in favour of the 75th percentile. Given the statutory test underlying the appeal process it seems clear that, had the Commission recommended using the 50th percentile that would also have survived appeal.

***The trade-off between over- and under-pricing is critical***

The term asymmetric risk was used in two distinct ways during the development of the input methodologies. One related to business risks, such as the exogenous risk of natural disasters and the more endogenous risks of technological progress and competitive entry. These issues are not directly relevant here. Rather, we are concerned with the risk, ultimately borne by customers, that the WACC will be under- or over-estimated. Adopting a customer-centric perspective, the task is therefore to assess the balance of risks and benefits associated with under- and over-pricing. There are two aspects to this trade-off: one concerns the impact of pricing errors directly, and the other relates to the consequential impact on investment outcomes.

***The only existing academic paper is only weakly relevant***

There is a paper by Dobbs(2011) that examines the relevant trade-offs. However Dobbs uses a total surplus welfare function which is not relevant under Part 4 of the Commerce Act. Moreover, his conclusions, which favour over-pricing (i.e. a percentile in excess of

the 50th) rely ultimately on a real options analysis. The Commission has already considered and rejected real options arguments and the Court did not over-turn these decisions.

***Pricing effects are asymmetric and suggest erring on the low side***

Using a standard welfare analysis we show that the benefits arising from under-pricing exceed the harm from over-pricing when both price differences are of the same size. The size of the asymmetry is twice the dead-weight loss from over-pricing. In respect of the pricing effect therefore, a percentile below the 50th is optimal. Dobbs (2011) also finds this result.

***Investment effects are also asymmetric***

Under-pricing will tend to defer efficient investment and over-pricing will tend to advance efficient investment. The resulting welfare effects depend on the specific investment and customers' valuations of the resulting services. However there is also a risk of *inefficient* investment, including what is known as "gold plating", but this only occurs with over-pricing. This asymmetric impact on investment, which is harmful to both consumer welfare and to total welfare, was first noted in the academic literature in 1962.

***There is no case for over-pricing in respect of airport WACCs***

There are three features of airports that affect the relevant welfare trade-off, and each of them undermine the case for over-pricing. First, airports are not subject to price control. Second, airport information disclosure is based on dual-till regulation which already increases the incentive for efficient investment, premature investment and inefficient investment. Third, airports are in regular consultation with a small group of informed customers; this provides opportunities to mitigate any risk that efficient investment will be deferred.

For these reasons, there is a strong argument that the 50th percentile is actually too high as a yardstick for the target return for airports and that the range of acceptable WACC should be centred no higher than the 50th percentile.

# 1 Introduction

This report responds to the Commerce Commission's recent announcement of further work on the Weighted Average Cost of Capital (WACC) in the context of regulation under Part 4 of the Commerce Act 1986.[1] It is concerned with one aspect of the way the allowance for the cost of capital is set in regulation under Part 4 of the Commerce Act 1986.

In setting the WACC allowance, it is normal to estimate several parameters separately and then combine them. Since each individual parameter is estimated with some error, the final WACC estimate is also subject to some uncertainty. The Commission expresses this uncertainty by means of a range, and its final determination of the WACC is effectively a chosen percentile of that range. The issue at hand is whether to use the 75$^{th}$ percentile or the 50$^{th}$ percentile (or potentially something else).

This report was commissioned by BARNZ but represents the views and analysis of Covec as independent economic experts.

We begin by outlining in this section:

- The statutory context for this work;
- The findings of the High Court; and
- The particular position of airports within the broader regulatory regime.

## 1.1 Statutory Context

The issues considered here stem ultimately from the regulatory regime established under Part 4 of the Commerce Act and in particular the purpose of that Part of the Act as described in section 52A(1) which we set out in full.

> The purpose of this Part is to promote the long-term benefit of consumers in markets referred to in section 52 by promoting outcomes that are consistent with outcomes produced in competitive markets such that suppliers of regulated goods or services—
>
> (a) have incentives to innovate and to invest, including in replacement, upgraded, and new assets; and
>
> (b) have incentives to improve efficiency and provide services at a quality that reflects consumer demands; and
>
> (c) share with consumers the benefits of efficiency gains in the supply of the regulated goods or services, including through lower prices; and
>
> (d) are limited in their ability to extract excessive profits.

[1] Commerce Commission, "Further work on the cost of capital input methodologies" 31 March 2014.

Clearly the stem of this section is the dominant purpose, namely to *promote the long term benefit of consumers*. Consumers are always on the customer side of the market for regulated services. In the first instance they may be firms using regulated services as required inputs into services that are on-sold to final consumers. It follows that the dominant purpose of regulation under Part 4 is to restrain the quality-adjusted prices of regulated services. This conclusion is only reinforced by s52G of the Act, under which there must be scope for the exercise of substantial market power in order for services to be regulated.

There has been debate on the status and legal function of the four "such that" terms in s52A(1)(a) – (d) inclusive. Even ignoring these subsections however, it is clear that s52A is not seeking the lowest possible prices. Two examples illustrate this point.

(a) Prices that merely recover operating costs could be sufficient to keep a regulated firm operating. However this pricing rule would be insufficient to bring forth new investments desired by consumers, because rational investors would not commit new funds unless they were assured of a reasonable opportunity for full cost recovery. So setting prices equal to operating costs only would not promote the *long term* benefit of consumers. Avoiding this outcome is particularised in s52A(1)(a) but it is also embedded within the dominant purpose of Part 4.

(b) A regulatory structure that stripped out all efficiency gains might also result in lower consumer prices in the short run, when compared with a system that allowed the firm to keep a share of efficiency gains. But firms are unlikely to pursue efficiency gains if they cannot derive at least some benefit from them. So a system that allows firms to keep a share of efficiency gains is better for consumers over the *long term*. Thus, while s52A(1)(b) and (c) particularise these protections, they are clearly also contained within the dominant purpose of Part 4.

In summary, it is clear that the purpose of Part 4 is to protect consumers from the exercise of substantial market power in situations where competition is ineffective at doing so. The interests of investors are relevant to this purpose primarily because it is in the long term interests of consumers to ensure that investors are willing to supply capital. In effect, the need to ensure ongoing participation of investors acts as a constraint in the Part 4 regime.

This analysis places the decisions made within the Part 4 regime into the familiar economic framework of constrained optimisation. Economics textbooks discuss the way individuals optimise their consumption over time (an objective) subject to their income (a constraint), and the way firms optimise profits (an objective) subject to the available technology and the price of inputs (constraints). In the case of Part 4, the objective is to maximise consumer welfare (through a combination of low prices and good quality service) subject to the constraint that investors are willing to supply financial capital.

## 1.2 High Court Findings

Against this background we now review the findings of the High Court in respect of selecting a percentile of the estimated range for the overall WACC. This analysis is restricted to the second part of section 6.11 of the Judgement which concern appeals by several parties over the choice of percentiles within a WACC range.

In this section of its Judgement, the Court proceeded on the basis that all of the parameters used by the Commission to make up the WACC were unbiased. In doing so it effectively dismissed claims by MEUG (the appellant) and some regulated firms that certain parameters contained either "generosities" or penalties. It noted that the Commission made estimates of "standard errors" for each of these parameters and combined those to develop a range of values within which it considered the true WACC would lie. There appears to be an implicit agreement that the probability distributions of the individual component parameters of the WACC are shaped in such a way that the final estimate of a range for the overall WACC is symmetric, so that the 50th percentile is the unbiased estimate of WACC.

It follows that selecting the 75th percentile involves a deliberate over-estimation of WACC. Recognising this point, the Court stated the following at ¶1461.

> This is clearly at odds with the s 52A(1)(d) purpose of limiting the ability of regulated suppliers to extract excessive profits. The Commission says as much in the Principal Reasons Papers. The question is whether this result – a likelihood – is justified by fear of failure to achieve the s 52A(1)(a) outcome of providing regulated suppliers with incentives to invest and innovate. The question is to be decided within the context of what best promotes the long-term benefit of consumers, the overriding purpose of Part 4.

This framing of the issue, as a tension between two things that are both good for consumers, seems entirely correct. The question is effectively whether consumers are better off in the long run by paying higher prices (ie prices consistent with the 75th percentile which embodies deliberate over-estimation), at least in the short run but quite possibly forever.[2]

The primary finding of the Court was that there is a remarkable dearth of evidence bearing on this question. The Judgement cites several statements by the Commission, its experts and experts for regulated firms, all of whom supported a deliberate over-estimation of WACC while lacking any supporting evidence for doing so.

As if to underline this point, the Court then goes on (from ¶1472 onwards) to advance some counter-arguments of its own to the choice of the 75th percentile including:

- That a fair return should be sufficient;
- That excess returns are unlikely to spur efficiency gains;

[2] As the Court notes at ¶1460, "all the Commission's reasoning points to the choice following from, in its view, unavoidable uncertainties and asymmetric costs being permanent features of the regulatory framework."

- That innovation is more likely to be spurred by need than plenty; and
- That the regulated services are inputs into almost all sectors of the economy so inefficiencies from excessive pricing are broadly promulgated

These arguments all point towards using the unbiased estimate (ie the 50th percentile), however the Court notes that they have a similar status to the ones arguing for the 75th percentile. Both sets of argument lack supporting evidence. Since the onus of proof was on the appellant and proof was not supplied, the appeal against the 75th percentile was dismissed.

This approach reflects the statutory provisions governing the appeals, under which appellants needed to establish that the Commission had failed to adopt an approach to the input methodologies that was "materially better" when assessed against the purpose statement in s52A. In effect, the Commission's determination is the default setting and appellants need to prove it could be improved.

Given the lack of evidence as described by the Court it seems likely that the 50th percentile for WACC, had it been selected by the Commission in its final input methodologies determination, would also have survived an appeal seeking to increase it to the 75th percentile. The fact that the Commission's experts had supported the 75th percentile does little to undermine this view, since as the Court noted, those views were not supported by evidence.

## 1.3 WACC for Airports

Airports are subject only to information disclosure (ID) regulation, whereas other sectors regulated under Part 4 of the Commerce Act are subject to regulation via the setting of price-quality paths. The statutory purpose of ID regulation is to "*ensure that sufficient information is readily available to interested persons to assess whether the purpose*" of Part 4 (discussed above) is being met.[3]

The predicted rate of return on capital is a central focus of ID regulation. In practice, the input methodologies seek to achieve the purpose of ID regulation by mandating the supply of enough clearly specified information to permit interested persons to estimate the rate of return on capital that airports will receive. As part of this process, the Commission defines a range of WACC values that serves as the comparator for airports' anticipated rates of return.

The Commission determined that a range between the 25th and 75th percentile of the WACC range was appropriate and further stated (in its Reasons paper) that the 50th percentile was an appropriate starting point for assessing profitability. In their appeal to the High Court, the airports argued that the same factors leading to use of the 75th percentile for price-quality regulation also applied to airports, and the Commission should require them to report the 75th to the 85th percentile range or an upper band materially higher than the 75th percentile.[4]

[3] S53A of the Commerce Act 1986

[4] High Court Judgement, ¶1425

The Court was not persuaded of this argument. It noted that the airports are not actually subject to price-quality control, and made particular mention of the statutory requirement for relevant information to be *readily* available.

Since it is common ground that the 50th percentile is an unbiased estimate of the actual WACC, it would seem essential to the purpose of ID regulation that interested persons be able to observe airports' financial performance relative to the 50th percentile. That benchmark would not be "readily available" if airports merely reported the 75th and 85th percentiles. To derive the 50th percentile, one would need to assume the underlying probability distribution is symmetric and *also* make an assumption about the kurtosis of the underlying probability distribution,[5] and then use that assumption as a basis for further calculations. It is therefore both complicated and reliant on an unusual assumption to derive the 50th percentile when the only information supplied are 75th and 85th percentiles.

By contrast, if the 25th and 75th percentiles are reported (as determined by the Commission) then an interested person merely needs to assume that the underlying probability distribution is symmetric, from which point it is readily deduced that the 50th percentile lies half-way between the 25th and 75th percentiles.

[5] Kurtosis refers to the 4th moment about the mean and is a measure of the "peakedness" of a probability distribution function.

# 2 Asymmetric Risk

All economic agents operate with imperfect knowledge of the future. Risk and uncertainty are therefore inevitable factors in many economic decisions. In the context of price-quality path regulated services, some risk is borne by investors who commit financial capital to investments in long-lived physical assets, and some risk is borne by the consumers of regulated services who are exposed to changes in the price or quality of those services.

The regulated allowance for a rate of return on capital has the effect of sharing risk between these two groups (investors and consumers) over time. For example, if the WACC allowance is set "too low" when assessed against the risks associated with investment, then

- Current investors will suffer a capital loss because the resulting lower prices will reduce the market value of their assets;
- Current consumers will gain value from receiving the same services at a lower price; and
- Future consumers will gradually lose value as new capital needed to maintain services levels is not installed due to a diversion of financial resources towards sectors where the risk adjusted rate of return is not too low.

In its Judgement (¶1715, 1716), the Court noted that asymmetric risks have been discussed in two ways in the process of developing input methodologies. Inspection of these two approaches shows that

- One relates to assessing the risks facing the firm, these being further divided between
    - Catastrophic risks exogenous to the industry such as earthquakes, and
    - Endogenous business risks arising from such events as new entry, technological progress; whereas

- The other form of asymmetric risk concerns risks facing the regulator, acting as the agent of consumers of regulated services, in attempting to achieve the statutory purpose of regulation.

The first category of issues, arising from any asymmetric risks that face regulated firms, was dealt with directly in the input methodology development process. The airports appealed the resulting determinations, asking for an uplift to the WACC of 1% - 2%, but their arguments were readily dismissed by the Court as being "devoid of merit" (¶1738).

It also seems clear from its invitation for submissions that the work the Commission is now undertaking excludes consideration of the first category of issues arising from any asymmetric risks that face regulated firms. The task at hand is therefore limited to considering how the choice of WACC percentile relates to the purpose of regulation under Part 4. This task differs across regulated sectors of course. In the case of airports a WACC percentile is intended to allow interested persons to compare targeted or actual

returns of airports with those that would be consistent with the purpose of Part 4 regulation.

It follows that references by airports to potentially asymmetric business risks are not relevant to the matter at hand. This group of irrelevant issues includes exogenous risks like earthquakes, pandemics or terrorism, and endogenous risks like the commercial threat of new airport developments.

What matters instead is whether the long term benefits of consumers of regulated services are better served by adding a margin of 25 percentile points to the unbiased central estimate of WACC. In what follows we examine this question in three ways:

- Using what seems to be the only published economic analysis of the relevant welfare asymmetries;
- By considering the way errors in regulated service pricing affects consumer welfare; and
- Through examination of the impact of pricing errors on efficient investment.

## 2.1 The Dobbs Model

As emphasised above, even actual evidence of asymmetric business risks borne by regulated firms is not relevant to the matter at hand. Rather, we need to look for evidence that assesses and/or evaluates the welfare trade-offs involved in setting a WACC allowance that is above or below the firm's true cost of capital.

In searching for this evidence it is important to remember that the welfare measure mandated by Part 4 is in fact consumer benefit, not total economic surplus, as discussed in section 1.1. The fundamental question is whether *consumers* are better off in the long run by erring in one direction or the other.

This means that the Dobbs (2011) paper[6] cited recently by Frontier Economics[7] is not directly helpful. In that paper, the author treats firm profits as part of the welfare function to be maximised, saying

> "The welfare measure used in what follows is the unweighted discounted sum of firm profits and consumers surplus, where the actual cost of finance is used as the discount rate."

One might also object to the Dobbs model on the basis that the price elasticity of demand is assumed to be in excess of unity. Price elastic demand seems an unusual assumption for regulated services, for which customers tend to be rather captive. Moreover, Dobbs seems to have in mind a demand curve that is not just slightly elastic: in his simulations he uses an elasticity of -3.

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[6] 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.

[7] Frontier Economics, 'Evidence in support of setting allowed rates of return above the midpoint of the WACC range', Report for Transpower, March 2014.

Notwithstanding these concerns, there remains some useful information in the Dobbs paper concerning the allowed WACC for pre-existing investment, i.e. for already sunk assets. Dobbs divides capital investment into three categories and examines each separately. The categories are:

- Already sunk investments made before the price-quality path is set;
- Potential new investments that have a 'now-or-never' characteristic; and
- Potential new investments that can be deferred to the next regulatory period.

Clearly the vast majority of assets relevant to a regulatory period will fall into the first category, being already sunk. Setting aside unusual events such as earthquake recovery or very significant capacity expansion, new investment is usually a fairly small fraction of the existing asset base, particularly when asset values are set fairly close to their replacement cost as applies to the present case.

For this dominant asset category, Dobbs concludes as follows.

> "It can be shown mathematically that the optimal value for [the cost of capital allowance] for this category lies *below the mean* value of the WACC distribution, although empirically, it generally lies quite close to the mean value" (emphasis added)

In the simulations reported, welfare is maximised for sunk investment by setting the WACC allowance at approximately the 45th percentile.[8] Bearing in mind the total surplus nature of Dobbs' welfare function, this finding indicates that consumers gain more from modest under-pricing of WACC than firms lose.

Turning to the other asset categories, Dobbs argues and we agree that very few investments will fall into category two. In most cases, investment decisions can be deferred albeit at some cost. We will therefore focus on category three.

This is of course just the familiar real options framework embedded into a regulatory model. In Dobbs' model the option to invest does not expire, so firms simply wait until a regulatory period in which the allowed return is sufficient to buy out their option to continue deferring investment. Depending on the underlying parameters, Dobbs finds that the "optimal" choice is to use percentile choices that range from the 79th to the 98th.

It appears that this higher allowance for new investment is permanent in Dobbs' model. Thus, even though recently invested capital is actually sunk at the beginning of the next regulatory period, it does not get paid at the 45th percentile applicable to other sunk investments. Thus, if the regulatory model was to distinguish between new and old capital (as suggested by MEUG), the proportion of the asset base that is being paid at

[8] This value was derived by linear interpolation between values Dobbs tabulates for the 40th and 50th percentiles. The relevant curve is approximately linear in this neighbourhood.

the higher rate for "new" capital (i.e. assets installed since the commencement of regulation) would increase over time.

Similarly, if one was to adopt this approach and use a weighted average of old and new capital to select the WACC percentile, the logic of the model seems to suggest that the chosen percentile would need to increase over time as "new" assets came to comprise an increasingly large share of total assets. That approach would effectively make the WACC percentile endogenous to the rate of capital investment. This feature seems not to have been modelled by Dobbs, though it seems certain to have an impact on the optimal timing of investment. If the WACC percentile increases over time, expected future revenues also increase for the firm. In a real options model that will advance the timing of investment, in the same way that demand growth does.[9] The implication is that a lower WACC percentile is optimal because the future is more attractive to firms.

More generally, even if we ignore for a moment the inappropriateness of a total surplus welfare criterion for the matter at hand, Dobbs' argument boils down to saying that the WACC should be higher because of real option values. This is a matter on which the Commission has already deliberated at some length. The Court summarised the outcome of those deliberations as follows.[10]

- Regulated firms are unlikely to be subject to the requisite degree of uncertainty for a real options approach to apply due to the long-term nature of regulation (comparable in many ways to a long-term contract) where an asset value is fixed at the moment it enters the RAB, and suppliers are allowed to earn a return on and of that investment. In workably competitive markets with sunk costs and uncertainty, the existence of long-term contracts mitigates the need for a real options approach.
- Assigning a positive value to real options could reward a regulated supplier for its position of market power, which would be inconsistent with the Part 4 purpose.
- There is no regulatory precedent for taking into account real options in the cost of capital (or RAB) even though other regulators have previously considered such arguments.
- To the extent that any Type II asymmetric risk[11] does exist, it is better dealt with through front loading of the depreciation profile or cash flows, or allowing stranded assets to remain in the RAB, as has been done by other regulators.

The first of these points seems particularly relevant. The real options literature emphasises that the strength of the incentive to delay investment (i.e. the size of the delay option value) depends primarily on just two parameters:

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[9] The impact of demand growth can be seen by comparing the last three rows of Dobbs' Table 2 with previous rows containing zero demand growth but identical other parameters. The optimal WACC percentile falls, for example from the 88th to the 79th percentile in comparing rows 7 and 12.

[10] High Court Judgement, paragraphs 1722 (c) to (f) inclusive.

[11] In this context, Type II asymmetric risk refers to endogenous events that are outside the normal run of business, such as new competitive entry.

- the anticipated rate of growth in the value of the investment, which value depends on the anticipated flow of revenues and costs; and
- the uncertainty associated with that growth rate.

Thus, option values are lower and less important the more a regulatory regime can provide investors with certainty over their future prospects. This point links directly to the Commission's motivation for undertaking this work, which is to increase the level of certainty available to investors because to do so will protect consumers from the risk that efficient investment will be deferred, and also because a more certain business environment has lower risks and therefore permits lower returns to owners of capital.

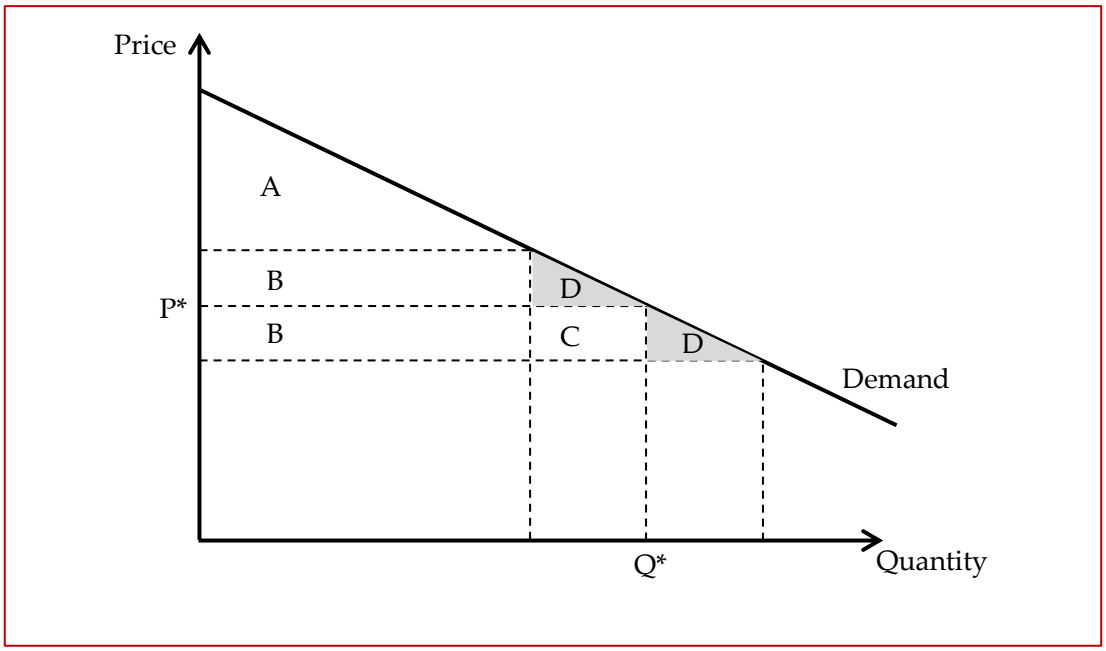
In conclusion, while there is a natural interest in the Dobbs model for the matter at hand, examination of it reveals two features that make it quite unsuitable. The first is Dobbs' use of a total surplus welfare function whereas the statutory objective is clearly the benefit of consumers, albeit with recognition that consumers also benefit from efficient investment. Secondly, if one was nevertheless tempted to implement the general approach used by Dobbs, it would be necessary to add extra layers to his model to reflect the fact that the WACC percentile would need to increase over time in line with the increasing proportion of total assets subject to a higher percentile, and the impact of this adjustment on the investment decision of firms.

## 2.2 Asymmetric Pricing Effect

It is possible to separate the impact of the WACC percentile decision into a pricing component which takes the existing capital stock as given, and an investment component relating to future investment. In this section we focus on the pricing component and show that the harm from over-estimating WACC is less than the benefits from under-estimating WACC. This finding is consistent with Dobbs' result that the optimal percentile for sunk investment is less than the 50$^{th}$ percentile.

The analysis is explained using Figure 1 below. In this diagram, areas with the same letter are the same size. If the regulator knew WACC for certain it would make no error, the resulting price would be P* and the quantity traded would be Q*. In the diagram, consumer surplus is the combined area lying between the demand curve and the horizontal line at P*, the size of which is A+B+D.

Figure 1: Pricing error analysis for given asset base




Now consider equal sized positive and negative errors. These shift the price up or down by the same amount and quantity also adjusts by the same amount down or up. If the price is too high, consumer welfare is reduced by B+D. If the price is too low, consumer welfare is increased by B+C+D. The consumer gains from under-pricing exceed losses from over-pricing by the area C, which is equal to twice the deadweight loss from over-pricing. The pricing effect is therefore asymmetric, and the direction of asymmetry points towards setting a WACC percentile that is *below* the 50th percentile.

There will also be knock-on effects throughout the economy arising from the use of regulated services as inputs into production. When final consumers buy goods and services that use regulated services as inputs, they are effectively buying those regulated services. It therefore seems reasonable to at least consider whether this propagation throughout the economy of the price of regulated services will tend to diminish or magnify the asymmetric effect noted above.

There is a literature on "asymmetric price transmission" which is relevant to this point. It seeks to understand the extent to which the output pricing of firms behaves differently according to whether input costs rise or fall. The most general paper appears to be work by Tappata (2009) who develops a model in which prices rise faster than they fall in response to input cost changes, even though there is no collusion between suppliers.[12]

Tappata has in mind the pass-through of commodity price fluctuations. The prices of commodities such as oil rise *and* fall, and workable competition will tend to ensure that downstream prices remain broadly in line with them. However if adjustment speeds

[12] Mariano Tappata, 2009, 'Rockets and feathers: Understanding asymmetric pricing', RAND Journal of Economics, 40 (4), pp. 673-687.

differ markedly, with prices "rocketing" up but only floating down like "feathers", then the impact is effectively asymmetric. There is empirical evidence of exactly this phenomenon, for example in financial markets,[13] electricity markets[14], and markets for agricultural products[15].

There is also some evidence of a similar effect closer to home. For example, Transpower's recent investment programme has been cited as a rationale for retail electricity price increases on 1 April 2014,[16] but electricity retailers have also been accused of not passing through reductions in distribution charges mandated by regulation[17]. This evidence is somewhat anecdotal but if such conduct is likely to be widespread, the implications are important.

In particular, asymmetric pass-through will tend to exert an upwards ratchet effect on the input costs of firms that use electricity (i.e. almost all firms), which will magnify the first round pricing asymmetry discussed using Figure 1. If WACC is over-estimated, final consumers will end up paying for the over-estimation, but the benefit of under-estimation will be captured (at least partly) by electricity retailers.

## 2.3 Investment Outcome Effects

It hardly needs to be said that the long-term benefits of consumers are promoted by ensuring that new capital investment is efficient. In this context, efficiency has two dimensions. It refers both to the nature of the assets being installed (i.e. their size, quality, location etc) and also to the timing of investment.

The impact of WACC estimation error on efficient investment can be readily identified, at least conceptually.

- If WACC is under-estimated, efficient investment will tend to be deferred;
- If WACC is over-estimated
    - Efficient investment will tend to be advanced; and
    - Inefficient investment will also tend to be undertaken.

The last point is of course the familiar result from Averch and Johnson (1962)[18] who showed that regulated firms will prefer to over-invest if capital is over-paid. In effect, investment is a kind of money pump that earns ongoing arbitrage profits from the

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[13] Boris Hofman and Paul Mizen, 2004, 'Interest Rate Pass-Through and Monetary Transmission: Evidence from Individual Financial Institutions' Retail Rates', Economica, 71, pp. 99 – 123.

[14] Georg Zachmanna and Christian von Hirschhausenb, 2008, 'First evidence of asymmetric cost pass-through of EU emissions allowances: Examining wholesale electricity prices in Germany', Economics Letters, 99(3), pp. 465 – 469.

[15] Awudu Abdulai, 2002, 'Using threshold cointegration to estimate asymmetric price transmission in the Swiss pork market', Applied Economics, 34, pp. 679 – 687.

[16] http://www.stuff.co.nz/nelson-mail/news/9775309/Power-prices-to-rise-again

[17] http://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=11112903

[18] Harvey Averch and Leland Johnson, 1962. 'Behavior of the Firm Under Regulatory Constraint', American Economic Review, 52 pp. 1052 – 1069.

margin between the allowed cost of capital and the true WACC. Inefficient investment has also been referred to as "gold plating" because it can sometimes take the form of installing an appropriate type of asset (e.g. a transformer) but making it more expensive than necessary (e.g. excessively large).
We can separate this from the timing issue by assuming for the moment that only efficient investment is being considered. In this context we need to compare the cost of having investment too soon against the cost of having it too late.

For capital installed at risk of being installed too late, consumers face the prospect of losing the surplus associated with the investment. The likely outcomes and costs will vary depending on the investment project.

- If the project relates to an energy network extension, for example to reticulate energy to a new location, then delay could probably be avoided by using a co-payment from the consumers affected to bridge the financing gap. That would be an obvious way to resolve an "all or nothing" stand-off.
- Similarly, if the project enhances aeronautical services at an airport in a manner desired by airlines, there would be strong incentives for agreement and no apparent impediment.
- If the project adds capacity to part of a network that is shared by many customers, agreements of this type may be difficult to reach. In that case consumers will bear the resulting congestion costs.

Unless the final example embodies a risk of catastrophic failure, perhaps because of very long construction times, waiting for congestion costs to emerge might well be a very efficient approach. However the broader point is that the investment deferral cost of under-estimating WACC will tend to vary across potential investments, and may be resolvable through direct agreement.

By contrast, the costs of over-estimating WACC are more certain. They are the holding cost on early efficient investment (i.e. the rate of return paid by consumers over the period between the date the investment was made and the date it should have been made), plus the full capital cost of any inefficient investment. In the case of a "gold plated" asset, the inefficiency is the extra and un-necessary cost of the "gold plating", whatever form that might take.

We are now in a position to summarise the combined effect of both the pricing effect analysed in section 2.2 and the investment outcome effects considered in this section.

For convenience, let us assume that the WACC error is actually large enough to affect investment outcomes. In that case, there are two risks to the welfare of customers: a risk of congestion, which (if it emerged) would provide useful and highly credible information about the desirability of further investment; and a risk of catastrophic outage.

If these risks are sufficiently costly, which in practice probably means there is a material prospect of catastrophic failure rather than merely congestion, then customers might

prefer to avoid such risk entirely by paying a higher WACC. Doing so would incur three types of cost:

- the holding cost associated with early efficient investment, which is equal to the regulated rate of return for the period over which the investment is premature;

- the full capital cost of any inefficient investment, which is capital installed in pursuit of arbitrage profits rather than because customers value the services it provides; and

- the pricing inefficiency noted above, which includes both a deadweight loss (arising from the fact that higher prices leads to less usage of the regulated services) and a wealth transfer to regulated firms via higher prices for all of the regulated services.

# 3 Compensation for Risk

Several submitters have argued that Commission should not isolate the WACC percentile issue but should instead include this issue in the broader review of input methodologies.[19] Doing so would have delayed consideration of the matter and opened up all of the other arguments regarding WACC that were canvassed during the input methodology development phase.

Even though the issue at hand is a relatively narrow one, the fact that asymmetric risk has been discussed in two separate contexts already[20] suggests that the Commission may need to be quite firm about restricting the scope of its deliberations. It may therefore be useful to briefly discuss the broader context in which the WACC percentile issue sits.

In general terms, the allowed earnings from a regulated service can be represented by the following expression.

$$E = r\,V + O + D$$

where r represents the allowed rate of return, V is the deemed value of the assets installed, O represents operating costs including tax and D is depreciation. All of the terms on the right hand side are relevant to allowed earnings in any period, and the numerical size of each of them is ultimately determined by the regulator.

In applying this model over time, there are some constraints that need to be respected. For example, the Commission has decided that V should evolve over time in lock-step with the time path of depreciation (D) and new investment. As new capital is added, V increases and as depreciation expenses are charged, V decreases; these are the only ways that V can change for specialised assets (other than CPI indexing).[21] In the case of default price path regulation and information disclosure regulation, there is no regulatory scrutiny of the capital assets being added so this is at the discretion of the regulated firm, which increases the risk of the inefficient investment of capital as discussed by Averch and Johnson (1962).

The asset valuation process also needs to be initialised, and these starting values were the subject of much debate during the input methodologies development process. Although the rolling forward to the asset base value V will be rather mechanical and will not require or permit any revaluation of existing specialised assets other than inflation indexing, the Commission adopted starting valuations based on recent revaluations based on replacement cost concepts. Strenuous challenges to these decisions were dismissed by the High Court.

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[19] See for example submissions by the Electricity Networks Association (13 March 2014) and the New Zealand Airports Association (13 March 2014).

[20] See ¶1715 – 6 of the Judgement of the Court.

[21] Note also that airports are permitted to periodically revalue their land to reflect MVAU, provided revaluations are booked as income.

It is fair to assume that the use of these recent replacement cost valuations was somewhat generous to regulated firms. That is not simply because of the history of regulated firms having "double dipped" in the past by not booking revaluation as income.[22] It is also because despite having a strong incentive and ample opportunity to demonstrate otherwise, regulated firms have not done so.[23]

More generally, there are many individual components that need estimating in order to set regulated earnings. This is particularly so within the WACC calculation itself. Clearly it would be dangerous (from the perspective of s52A) for the Commission to consistently err towards over-stating costs and prices. Doing so across numerous component estimates would lead to error compounding and a material bias in favour of investors.

As the Court effectively noted,[24] it is important that WACC and other components of the regulatory model be estimated in an unbiased way. The result will be a type of averaging out caused by a combination of over- and under-estimations.

There are of course also other forms of diversification available to investors. This occurs by the compilation of portfolios of assets, the returns on which are imperfectly correlated, and also through the time dimension as some decisions resulting in an element of over-payment are offset by earlier or later decisions tending in the opposite direction.

## 3.1 Specific Features of Airports

The WACC percentile issue is somewhat different for airports compared with other regulated service providers. There are three main reasons. First and most obviously, Airports are not subject to price-quality regulation but are instead obliged only to disclose information and they remain legally able to set their own prices.

Secondly, the dual-till nature of the regulatory model underlying the information disclosure obligations changes the trade-offs discussed in sections 2.2 and 2.3 above. It will be recalled from those sections that:

- The pricing effect of a WACC percentile choice is asymmetric, with more harm caused by over- than under-pricing;
- The investment outcome effect
    - Includes an asymmetric risk of inefficient investment arising from over-pricing; and
    - Ultimately depends primarily on whether under-pricing creates a material risk of catastrophic failure.

[22] Geoff Bertram and Dan Twaddle, 2005, 'Price-Cost Margins and Profit Rates in New Zealand Electricity Distribution Networks Since 1994: the Cost of Light Handed Regulation', Journal of Regulatory Economics, 3, pp. 281-308.

[23] See High Court Judgement ¶774 – 775.

[24] See the Court's discussion around ¶1458 for example.

In the case of airports, it is well known that investment incentives are strengthened by using dual-till (rather than single-till) regulation.[25] This is because earnings from the un-regulated parts of an airport's business (e.g. retail developments, car-parking etc) are influenced by the throughput of traffic generated from aeronautical activities. Other things being equal, an airport will prefer more foot traffic than less. This will make airports somewhat less likely to defer efficient investment in aeronautical assets in response to an error by regulators that results in under-estimation of WACC for a regulatory period.

This kind of effect is not present for other regulated service providers, who can be thought of as effectively acting under single-till regulation.

The third airport-specific factor arises from the consultations that airports are obliged to undertake with airlines. While these consultations do not bind the pricing of airports in any legal way, they do provide a regular opportunity for direct customer engagement, a process that is enhanced by the fact that airports have relatively few customers for regulated services (compared with electricity networks).

If airports were about to defer or avoid efficient investment, and their customers would suffer from this, then the matter could presumably be resolved, either during a periodic pricing consultation process or through direct engagement between the airlines and airport in question during the pricing period. The customer focus of s52A is important here: deferring investment is only a problem if (fully informed) customers perceive it as such. In the case of airports, those customers have opportunities to avoid such problems. The key point is that the opportunity exists for airlines to seek either advancement or deferral of investment projects.

[25] Tae Oum, Anming Zhang, and Yimin Zhang, 2004, 'Alternative Forms of Economic Regulation and their Efficiency Implications for Airports', Journal of Regulatory Economics, 38, pp. 217 – 246.

# 4 Conclusion

There has to date been little if any hard evidence on the trade-offs arising from the choice of a WACC percentile under regulation pursuant to Part 4 of the Commerce Act 1986. This was noted with concern by the High Court in its Judgement on appeals against the input methodologies, and has prompted this further work by the Commerce Commission.

Our analysis offers a framework within which such evidence can be evaluated, but it seems clear that any empirical evaluation will need to be context specific. We have separated the effects of over- and under-estimation of WACC into impacts on pricing and investment, and analysed the welfare implications of each bearing in mind the statutory focus on the long-term benefits to customers.

The pricing effect alone suggests that the optimal percentile is less than the 50$^{th}$, because consumers suffer more harm from over-pricing than they gain by a similar level of under-pricing.

Investment outcomes point in the same direction in the sense that there is one extra category of cost arising from over-pricing than under-pricing. This is the risk of inefficient investment, being the installation of assets that customers do not want.

Both of these conclusions could however be over-turned if there is a material risk of catastrophic service failure arising from under-pricing.

We consider that this trade-off is very unlikely to justify a WACC percentile in excess of the 50$^{th}$ for airports because of three specific features of these firms:

- Regulation being restricted to information disclosure;
- Dual-till regulation which gives stronger investment incentives at the margin; and
- Regular consultation between airports and a small group of well-informed customers.

These are in addition to the more basic point, applying to all regulation under Part 4 that consumer surplus is paramount and is diminished by over-pricing.

There is a strong argument that the 50$^{th}$ percentile is actually too high as a yardstick for the target return for airports and that the range of acceptable WACC should be centred no higher than the 50$^{th}$ percentile.