Cost of equity issues related to Input Methodologies review

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Executive summary

Frontier Economics (Frontier) has been asked by Transpower New Zealand (Transpower) to provide our views on the various issues related to the estimation of the cost of equity canvassed by the Commerce Commission (the Commission) in its recent consultation paper *Input methodologies review: Update paper on the cost of capital topic* (the Update Paper). This report provides our views on four issues:

1. The Commission's approach to estimating the Tax-adjusted Market Risk Premium (TAMRP);
2. The Commission's approach to beta estimation;
3. The use of alternative models to the Sharpe-Lintner-Mossin Capital Asset Pricing Model (SLM-CAPM); and
4. MEUG's proposal that the Commission should apply the so-called Black's Simple Discount Rule (BSDR).

Estimation of the TAMRP

Our main conclusions in relation to the Commission's approach to the TAMRP are the following:

- There is very convincing evidence that the risk premium demanded by equity investors varies over time. However, since 2004 the Commission has consistently (except for a brief period between 2010 and 2011) determined a fixed number for the TAMRP of 7.0%.
- The Commission's policy of holding the TAMRP fixed has not produced sensible outcomes. The Commission's CAPM estimates of the cost of equity have effectively tracked movements in government bond yields, which have declined to all-time lows since 2009. As a result, the approach codified in the existing Cost of Capital IM would have implied, during the worst financial crisis since the Great Depression, that equity capital has never been cheaper.
- Whilst the Commission considers estimates derived using different approaches, and those estimates display a reasonable degree of variation, the Commission keeps arriving at the same estimate of the TAMRP, 7.0%. A key reason for this is because the Commission's approach to assessing the empirical evidence on the TAMRP has a tendency to entrench the traditional estimate:
  - Most of the approaches the Commission considers produce estimates that move very slowly over time (i.e., Ibbotson, Siegel 1 and surveys). If the Commission computes a mean estimate of the TAMRP, estimates from the few approaches that vary more with prevailing market conditions (i.e., DGM, Siegel 2) would generally have to be implausibly high to move the Commission away from its traditional estimate of 7.0%.

- If the Commission computes a median estimate of the TAMRP, during periods when prevailing market conditions deviate significantly from average market conditions, the ordinal ranking of estimates will generally mean that slow-moving estimates (e.g., Ibbotson and/or surveys) will determine the final estimate of the TAMRP (and estimates from all other sources will generally be discarded). Again, this will tend to result in persistent estimates of 7.0%.
- Finally, the Commission's policy of rounding TAMRP estimates to the nearest 0.5% also makes it very difficult for the overall estimate to deviate from a figure of 7.0%. There is no economic or regulatory rationale for rounding estimates in this way, but this practice can have a non-trivial impact (upwards, or downwards, depending on the direction of rounding) on revenues.

- We recommend that the Commission no longer compute simple mean or median estimates of the TAMRP, and no longer round estimates to the nearest 0.5%.
- Instead, we recommend that the Commission weight approaches according to their relative strengths, and according to prevailing market conditions:
  - Ibbotson and Siegel 2 estimates have useful information to contribute, and should be viewed as opposite ends of a spectrum. In our view, the default setting (i.e., in the absence of evidence to the contrary) should be to attach equal weight to these two approaches. However, when the Commission is estimating the TAMRP, if there is extraneous evidence that the total return on equity required by investors is similar to the historical average, relatively more weight should be given to the Siegel 2 estimate. If, on the other hand, there is extraneous evidence that shows that risk premiums have increased (relative to historical average levels), relatively more weight could be given to the Ibbotson estimate.
  - The Dividend Growth Model (DGM) offers the best prospects for estimating prevailing equity risk premiums, because the main inputs to the model are current asset prices and prevailing dividend forecasts. Empirically, the DGM has tended to produce high estimates during times when market indicators suggest that investors have demanded high risk premiums, and low estimates during times when market indicators suggest that investors have demanded low risk premiums. The DGM also tends to produce estimates consistent with Ibbotson during average market conditions. If the Commission wishes to derive estimates that reflect risk premiums in prevailing market conditions, it should give primary (but not exclusive) weight to the DGM.
  - Siegel 1 is essentially a variant of Ibbotson. Hence, if the Commission computes a mean estimate of the TAMRP, it would be giving double

weight to the same underlying evidence.[1] If the Commission computes a median estimate, because Siegel 1 estimates will typically sit below Ibbotson estimates, Siegel 1 plays the role of nudging the Ibbotson estimates towards the middle of the ranking of estimates, thereby increasing significantly the likelihood that the Ibbotson estimates will determine the Commission's overall TAMRP estimates.

- A key prediction crucial to the validity of Siegel 1 (i.e., that real government bond yields would rise from levels seen in the late 1990s, and remain high) has been comprehensively proved wrong. In our view, there is no sound basis for Siegel 1, and the Commission should not use this approach when estimating the TAMRP.
- Survey evidence has several major shortcomings and is inherently less reliable than all of the other approaches considered by the Commission. Survey evidence should be given minimal weight by the Commission.

- The Commission should not lock in a TAMRP figure into the Cost of Capital IM. Rather, the Commission should re-estimate the TAMRP, according to a methodology set out in the Cost of Capital IM, each time such an estimate is required. Doing so would increase the chances of the TAMRP estimate reflecting prevailing market conditions — particularly if the recommendations we have outlined above are implemented.

Beta estimation

Our main conclusions in respect of the Commission's approach to beta estimation are the following:

- Because the Commission derives beta estimates using weekly and monthly returns data, and because these estimates are based on a single reference day (for each of those two returns frequencies), the Commission's estimates may be prone to significant estimation error arising from selecting one reference day over others. This type of sampling error is referred to in the empirical finance literature as reference day risk.
- Reference day risk can be reduced significantly by deriving estimates using every possible reference day, and then averaging over all of those estimates. Such a process will tend to cancel out much of the random sampling errors introduced into the estimates by favouring one reference day over others.
- The Commission's current approach uses five year sample periods when estimating betas. There is nothing special about five years. However, lengthening the sample period increases the statistical precision of estimates.

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1 The Commission's expert, Dr Lally, has recently disputed this point. We explain in this report why we disagree with Dr Lally on this issue.

Further, empirical evidence in the finance literature shows that the ability of beta estimates to predict future stock returns increases as the estimation window is lengthened. This implies that all available historical data should be used when estimating betas.

- The beta estimates of illiquid stock are known to be biased downwards. In the existing Cost of Capital IM, the Commission attempts to filter out illiquid comparators by applying a very blunt rule: any comparators with a market capitalisation less than $100 million are dropped. This size filter fails to recognise that some small comparators can be liquid, and some large comparators can be thinly traded. There are better liquidity filters that take account of volatility and volume of trade, rather than relying on size being an indicator of illiquidity. We have applied the Amihud metric and have identified some comparators as potentially illiquid, which the Commission's approach failed to identify.

Use of other models to improve the SLM-CAPM

- The Commission's suggestion that models other than the SLM-CAPM are rarely used by practitioners and regulators is incorrect:
  - There is substantial evidence that corporate finance advisers make adjustments to their SLM-CAPM estimates, at least in part to compensate for weaknesses in the SLM-CAPM. The final effect of some of these adjustments is the application of a model that is something other than the SLM-CAPM.
  - Regulators in North America commonly use the Black CAPM, in many instances alongside the SLM-CAPM.
  - Those regulators in Australia that have given detailed consideration to the Black CAPM since the promulgation of the existing Cost of Capital IM in New Zealand have concluded that the Black CAPM can be used to improve their SLM-CAPM estimates of the cost of equity.
- Estimates of the zero-beta premium, obtained by estimating the Black CAPM, can be used to derive improved SLM-CAPM estimates, i.e., estimates that correct for the low-beta bias of the SLM-CAPM that is now well-established empirically in the finance literature.[2]
- We recommend that the Commission continue to use the SLM-CAPM to estimate the cost of equity, but use estimates from the Black CAPM to improve

[2] We have estimated the zero-beta premium previously using Australian data. There is no reason why a similar exercise could not be performed using New Zealand data. We have shown that the betas corrected for this bias are relatively insensitive to the size of the zero-beta premium.

its cost of equity estimates by correcting for the well-recognised low-beta bias associated with the SLM-CAPM. This would require only a minor refinement to the existing Cost of Capital IM.

Black's Simple Discount Rule

In our view, the BSDR has no useful role to play within the regulatory framework for the following reasons:

- The BSDR could only produce risk-neutral cash flow estimates, which would serve no useful purpose in the regulatory process anyway;
- The implementation of the BSDR would be complex and inevitably controversial; and
- The outcomes produced by implementing the BSDR would likely be volatile and unstable over time.

We recommend that the BSDR play no part in the Cost of Capital IM.

1 Introduction

On 30 November 2015 the New Zealand Commerce Commission (the Commission) published a report entitled *Input methodologies review: Update paper on the cost of capital topic* (the Update Paper), which invited submissions from interested parties on a range of cost of capital issues.[3] Frontier Economics (Frontier) has been asked by Transpower New Zealand (Transpower) to provide our views on the various issues related to the estimation of the cost of equity canvassed in the Update Paper.

This report provides our views on:

- The Commission's approach to estimating the TAMRP (Section 2); and
- The Commission's approach to beta estimation (Section 3).
- The use of other models to improve the SLM-CAPM (Section 4);
- MEUG's proposal that the Commission should apply what has been referred to as Black's Simple Discount Rule (BSDR)(Section 5);

Where possible, in this report we develop further the ideas introduced in our earlier report to Transpower entitled *Recommendations on priorities for review of cost of capital input methodology* (our August 2015 report). We also focus on providing evidence on these issues to assist the Commission in its consideration of the issues above.

3 Commission (2015).

2 Estimation of the TAMRP

In our August 2015 report, we recommended that the Commission implement a more explicit and structured approach to assessing the evidence available to estimate the Tax Adjusted Market Risk Premium (TAMRP). The Commission's Update Paper sought further views on this issue, and urged submitters to consider and comment on its final decision on the TAMRP in relation to the UCLL/UBA final pricing principles (the UCLL/UBA decision).[4]

Having reviewed that recent decision, we are of the view that the Commission should give close attention to how it assesses evidence on the TAMRP. This section sets out what, in our view, are the main shortcomings of the Commission's current approach to estimating the TAMRP, and our recommendations for improvements.

2.1 The TAMRP varies over time

It is well accepted, including by regulators, that the market risk premium (MRP) varies over time. For example, the AER (2013, p.91) states that:

> Evidence suggests the MRP may vary over time. In their advice to the AER, Professor Lally and Professor Mackenzie and Associate Professor Partington have expressed the view that the MRP likely varies over time.

Similarly, IPART (2013, p.2) has developed a whole process for estimating separately the MRP using long-term averages and the using current market data (see section 2.7.1), because it recognises that the MRP changes as market conditions evolve over time.

The QCA (2014, pp.22-23) has acknowledged that the MRP can vary as market volatility and investor risk aversion changes, and that this likely occurred during and after the GFC. As a result, the QCA revised its traditional MRP estimate of 6% up to 6.5%.

The fact that the MRP varies over time has also been noted by central banks. For instance, in 2010 the Bank of England undertook a study of the movement in equity prices before, during and in the immediate wake of the GFC and concluded that the MRP had increased substantially during the crisis, relative to historical levels.[5] Further, as we noted in our August 2015 report, in a speech in New York on 21 April 2015, the Governor the Reserve Bank of Australia, Glenn Stevens

4 Update Paper, paras. 2.27 and 2.46.4.

5 Bank of England (2010), p.30.

stated that the risk premium demanded by equity investors appears to have risen since the onset of the GFC:[6]

> …post-crisis, the earnings yield on listed companies seems to have remained where it has historically been for a long time, even as the return on safe assets has collapsed to be close to zero [Figure 4]. This seems to imply that the equity risk premium observed ex post has risen even as the risk-free rate has fallen and by about an offsetting amount. [Emphasis added]

2.2 The Commission's estimate of the TAMRP does not vary over time

However, as Table 1 shows, since 2004 the Commission has consistently estimated the TAMRP to be 7.0%, with the exception of a brief period between 2010 and 2011, when it raised its TAMRP estimate to 7.5% in recognition of the global financial crisis (GFC).[7]

Table 1: Summary of Commissions' decisions on TAMRP over time

Decision	Year of decision	TAMRP estimate
Airfields activities	2001	8.0%
Telecommunications Service Obligation 2001-2002	2003	9.0%
Gas pipelines	2004	7.0%
Draft Cost of Capital Guidelines	2005	7.0%
Telecommunications Service Obligation	Annual decisions from 2005 onwards	7.0%
Unison post-breach inquiry	2007	7.0%
Revised Draft Cost of Capital Guidelines	2009	7.0%
Cost of capital Input Methodology	2010	7.5% (2010 and 2011 calendar years) 7.0% (2012 onwards)
UCLL/UBA decision	2015	7.0%

Source: Various Commission decisions

6 Glenn Stevens, Speech to the Australian American Association, New York, 21 April 2015.

7 The stability in the Commission's estimates of the TAMRP is acknowledged by the Commission itself in the Cost of Capital IM. See Commission (2010), para H7.46, p.485.

It seems that the Commission has an unstated view that the TAMRP is fixed over time. This is evidenced not just by the fact that the Commission has consistently determined a TAMRP of 7.0% since 2004, but also by the fact that:

- In the Commission's 2005 Draft Cost of Capital Guidelines[8] and its 2009 Revised Draft Cost of Capital Guidelines[9] (precursors to the existing Cost of Capital IM), the TAMRP was the only parameter (apart from the corporate and investor tax rates) for which the Commission determined an estimate. In those two Guidelines, the discussion of all other parameters (e.g., the risk-free rate, beta, debt premium) was restricted to conceptual considerations about how those parameters could be estimated.
- In the existing Cost of Capital IM, the Commission's estimate of the TAMRP is specified and held fixed, at least until such time as the Cost of Capital IM is revised. By contrast, estimates of other parameters, which the Commission considers to vary over time (e.g., the risk-free rate), are not specified in the Cost of Capital IM, but are to be estimated using contemporaneous market data each time the Commission makes a determination on the cost of capital.

2.3 The Commission's policy of holding the TAMRP fixed has not produced plausible outcomes

The period since 2004 has represented one of the most tumultuous in financial markets ever observed globally. The early 2000s saw one of the largest and most sustained bull markets, followed by the greatest financial crisis since the Great Depression. More recently, some economies have rebounded strongly. These effects have been felt in New Zealand financial markets as well, as demonstrated by Figure 14.

Between, January 2004 and July 2007, the NZX50 index rose by over 117%. Then, with the onset of the GFC, the NZX50 index fell by nearly 60% between July 2007 and March 2009. Subsequently, with the economic boom that has occurred in New Zealand since the GFC, the NZX50 index has risen by over 160% since March 2009. The perfect stability of the Commission's TAMRP estimates over time stands in stark contrast to the volatility experienced by investors over the same period.

8 Commission (2005), para. 80.

9 Commission (2009), para. 164.

Figure 1: NZX50 index over time

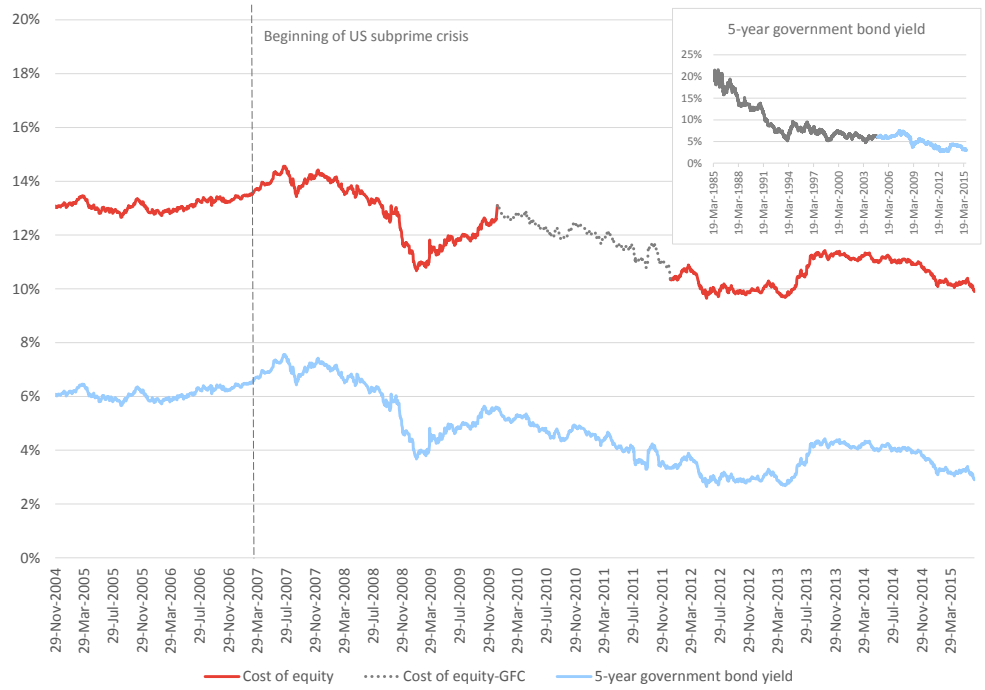
Source: Datastream

The Commission's approach of fixing its estimate of the TAMRP at 7.0% since 2004, whilst estimating the risk-free rate using the prevailing (i.e., one-month average) yield on five-year government bonds, has meant that the Commission's CAPM estimates of the cost of equity have effectively tracked the movements in government bond yields over time. This has resulted in implausible, counterintuitive regulatory outcomes. Specifically, as demonstrated in Figure 2, the cost of equity, assessed using the Commission's approach:

- was fairly flat (and even increased slightly) between the end of 2004 and mid-2007, when the start of the US subprime crisis heralded the onset of the GFC; and
- fell sharply as the GFC took hold between 2007 and 2009.

The decline in the cost of equity estimates using the Commission's approach post-2007 was driven by a significant drop in New Zealand government bond yield caused by a global flight to quality as investors substituted risky assets for safe haven investments. As the chart inset to Figure 2 shows, the period since 2007 saw five-year New Zealand government bond yields fall to the lowest point since records have been kept. Because the Commission's cost of equity estimates move in lock-step with government bond yields, not only did the Commission's methodology produce declining estimates of the cost of equity during the worst financial crisis since the Great Depression, the approach also implied that over that period, equity capital was cheaper than ever before. By any reasonable analysis, these are not sensible outcomes, and indicate a serious weakness in the Commission's approach to estimating the TAMRP.

Figure 2: Cost of equity estimates implied by the Commission's approach to TAMRP



Source: RBNZ, Frontier calculations

Notes: The red and grey curves in the main chart plot cost of equity estimates for an average firm (i.e., with a beta of 1) derived using the Commission's methodology. This involves adding to the Commission's estimate of the TAMRP the Commission's estimate of the risk-free rate (i.e., a one-month average of prevailing yields on five-year government bond yields computed using annualised returns). The red curve plots the implied cost of equity during the period the Commission applied a TAMRP estimate of 7.0%; the grey curve plots the implied cost of equity during the period the Commission applied a TAMRP estimate of 7.5%. The chart inset plots the average nominal yield on 5-year New Zealand government bonds since data on those yields became available in 1985.

2.4 The Commission's process for estimating the TAMRP

In its UCLL/UBA decision, the Commission notes that its TAMRP estimate is derived by examining a range of methods and estimates:[10]

> Our current TAMRP estimate is based on multiple methods, as recommended by Dr Lally.[99] Historically, including in the IMs, we have set a value of the TAMRP considering a range of information sources. The most common approach for estimating the TAMRP is to use historic returns on the market. While ex post returns have fluctuated significantly over time, regulators and practitioners have typically used or placed weight on estimates over long periods of time. Long-term estimates of historic returns are seen as useful predictors of future expected returns.

10 Commission (2015, UCLL/UBA), para.176.

The Commission went on to say that its methodology places weight on a wide range of estimates rather than preferring one approach over others:[11]

> Given that the various approaches to estimating TAMRP produce significantly different estimates of TAMRP, and that no approach to estimating TAMRP is generally accepted as superior or free from methodological criticisms, we prefer to place weight on a wide range of estimates (as Dr Lally does), rather than strongly preferring one approach (such as CEG's DGM analysis) over others.

The Commission has made similar statements in past decisions.

Investigation of the various TAMRP estimates that the Commission has considered in the UCLL/UBA decision, and in previous decisions, reveals that:

- Those individual estimates have been quite widely dispersed; and
- The range produced by various estimates is not static over time, but changes.

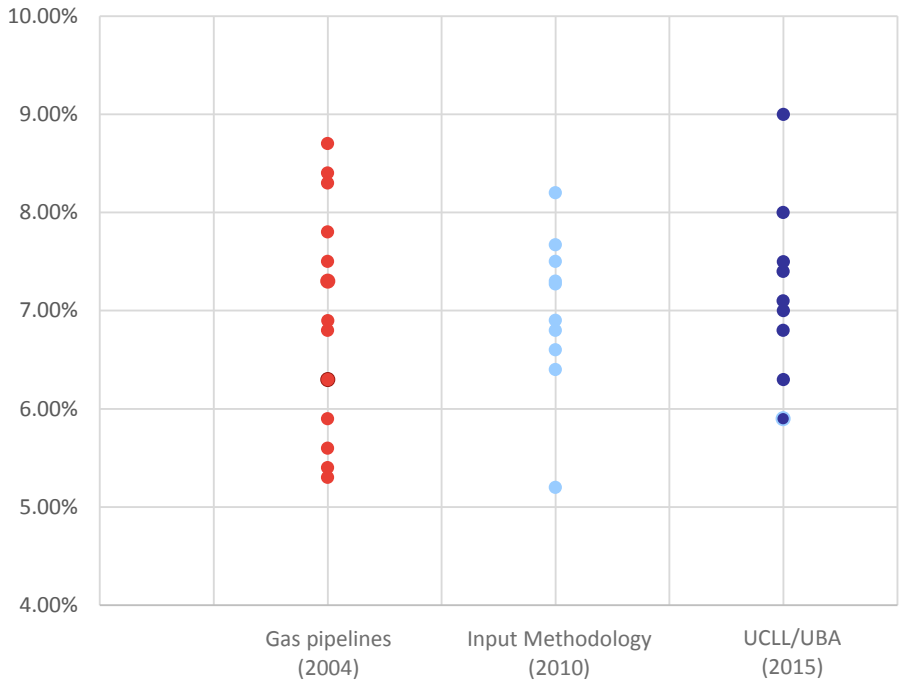
This is shown in Figure 3, which plots the range of TAMRP estimates (from different methods) considered by the Commission in three key decisions in which the Commission set out in detail the evidence it had considered:

- In the 2004 Gas pipelines decision, the Commission considered TAMRP estimates as low as 5.3% and as high as 8.7% (a range of 3.4%);
- In the 2010 Cost of Capital IM, the Commission considered estimates as low as 5.2% and as high as 8.2% (a range of 3.0%); and
- In the 2015 UCLL/UBA decision the Commission considered estimates as low as 5.9% and as high as 9.0% (a range of 3.1%).

Yet, in all these decisions, the Commission arrived at the same estimate of 7.0%. How is that possible if the Commission is truly placing "weight on a wide range of estimates", and if the range implied by those estimates is changing over time? As we explain below, the way in which the Commission is interpreting the evidence it considers encourages a finding of a TAMRP estimate that hardly changes over time. That does not mean that the Commission is always producing good estimates of the TAMRP. To the contrary, the Commission's approach will produce reasonable estimates of the TAMRP in some circumstances, and very poor estimates that are implausible in other circumstances. In the sections below we explain why this is so.

11 Commission (2015, UCLL/UBA), para.192.1.

Figure 3: Dispersion of evidence on TAMRP in key Commission decisions



Source: Various Commission decisions

To aid in that explanation, we begin by outlining briefly the approach the Commission took in its two most recent, major assessments of the TAMRP: the existing Cost of Capital IM; and the UCLL/UBA decision. In doing so, we highlight the areas of consistency and the areas where the Commission's approach has evolved between the two decisions.

2.4.1 Cost of Capital Input Methodology

In the existing Cost of Capital Input Methodology, the Commission's approach to estimating the TAMRP was based ostensibly on four different approaches:

1. **Ibbotson**: An historical average of market excess returns (annual observations of the difference between the return on a broad stock market index and the government bond yield);[12]

[12] Although the Commission refers to this approach as the 'Ibbotson' approach, the estimates used by the Commission are not in fact derived by Ibbotson. The Commission says in its Cost of Capital IM that its Ibbotson estimates are derived by Dimson, Marsh and Staunton (see Commission (2010), para. H7.28). However, in fact the Commission's Ibbotson estimates are obtained from Dr Lally, who bases his estimates not on work by Dimson, Marsh and Staunton, but an updating of Lally and Marsden (2004). For clarity on this point, see Lally (2015), p.22.

2. **Siegel**: The Ibbotson estimate, adjusted down based on the premise that (a) historically, unanticipated inflation artificially reduced the real return on bonds but not the real return on equities, and (b) such unanticipated inflation will not recur in future and real bond yields in the future will be higher than they were in the past;
3. **Cornell**: A version of the Dividend Growth Model (DGM) where the estimate of the TAMRP is derived from dividend yields and expected dividend growth rates; and
4. **Surveys**: The self-reported views of finance and economics academics, analysts and managers of companies who respond to surveys.

Estimates using all these approaches were derived for New Zealand and the US. In addition, an Ibbotson estimate and a Siegel estimate were derived for 16 other foreign markets. The Commission then computed the mean and median over each of the estimates, the results of which are reproduced in Table 2.

Table 2: Evidence on the TAMRP considered by the Commission in the IM

Methodology	New Zealand	US	Other	All
Ibbotson	7.27%	7.67%	7.50%	
Siegel	6.40%	7.30%	6.60%	
Cornell	5.20%	6.80%		
Survey	8.20%	6.90%		
Median	**6.84%**	**7.10%**	**7.05%**	**7.09%**
Mean	**6.77%**	**7.17%**	**7.05%**	**6.98%**

Source: Commission (2010), Table H12, p.494.

The Commission noted that these mean and median estimates (and other cross-checks) supported the Commission's 2008 Gas Authorisation TAMRP estimate of 7.0%. On that basis, the Commission's estimate of 7.0% from its 2008 Gas Authorisation was re-adopted by the Commission in the existing Cost of Capital IM, except for the 2010 and 2011 calendar years, in which it applied an arbitrary 0.5% uplift to its TAMRP estimate in response to the GFC.

2.4.2 UCLL/UBA decision

In the UCLL/UBA decision, the Commission considered TAMRP estimates derived using all four of the approaches it examined when developing the Cost of Capital IM. There were, however, a number of differences:

1. The Commission considered a fifth approach, which it presented as an alternative version of the original Siegel approach. To distinguish the two

approaches, the Commission referred to the original Siegel approach (which it used in the Cost of Capital IM) as 'Siegel 1', and the new approach as 'Siegel 2'. Siegel 2 involves estimating the real market return using a long historical average, converting that return to a nominal rate today using a current inflation forecast, and then deducting the current risk-free rate (net of tax).[13] This approach is essentially what regulators in Australia now refer to as the 'Wright approach' (after Professor Stephen Wright, Birkbeck College, who proposed this as an approach that the AER should consider).

2. In the Cost of Capital IM, the Commission considered both the mean and median of estimates from all approaches, whereas in the UCLL/UBA decision the Commission considered only the median across estimates from all approaches.

3. As in the Cost of Capital IM, the Commission presented TAMRP estimates using evidence from other foreign markets. However, in the UCLL/UBA decision the Commission's estimates for other foreign markets (20 in total) included estimates for the US, whereas in the Cost of Capital IM estimates relating to the US are presented separately from estimates for other foreign markets (17 in total). As a result, estimates from the US were given less weight in the UCLL/UBA decision than they received in the Cost of Capital IM decision.[14]

4. In the UCLL/UBA decision, the Commission says explicitly that it rounded its median estimates to the nearest 0.5% in order to arrive at its final TAMRP estimate of 7.0%.[15] Whilst the Commission effectively did the same thing in the Cost of Capital IM, it did not describe rounding in this manner as part of its approach.

The evidence considered by the Commission in the UCLL/UBA decision is summarised below in Table 3.

13 Lally (2015), p.29.

14 For instance, in the Cost of Capital IM, the median across all estimates from all markets, 7.09%, is equal to the average between the Ibbotson estimates for New Zealand (7.27%) and survey estimates for the US (6.90%). However, as the Commission did not present separately any evidence on the estimates relating to the US in the UCLL/UBA decision, survey evidence (or any other evidence from the US) exerts no influence on the median computed (except indirectly, via any diluted influence the US may have on the average estimate across all 'other foreign markets').

15 Commission (2015 UCLL/UBA), para. 191, p.45.

Table 3: Evidence on the TAMRP considered by the Commission in the UCLL/UBA decision

Approach	New Zealand	International markets
Ibbotson	7.10%	7.00%
Siegel 1	5.90%	5.90%
Siegel 2	8.00%	7.50%
DGM	7.40%	9.00%
Surveys	6.80%	6.30%
Median	**7.10%**	**7.00%**

Source: Commission (2015 UCLL/UBA), Table 4, p.46

2.5 Problems with the Commission's approach to estimating the TAMRP

The UCLL/UBA decision and the Cost of Capital IM reveal a number of major shortcomings with the Commission's approach, which we recommend the Commission address:

- The application of a simple mean or a median to the evidence will tend to result in TAMRP estimates that are driven by slow-moving measures, which, in unusual market conditions, will reflect very poorly prevailing perceptions about market risk. The Commission's weighting of evidence from different approaches should take account of the relative strengths or characteristics of different techniques, as well as prevailing market conditions.
- There is no economic or regulatory rationale at all for the Commission's approach of rounding estimates to the nearest 0.5%. When combined with the approach of using median estimates (as the Commission did in the UCLL/UBA decision), such a practice will tend to entrench the Commission's traditional TAMRP estimate of 7.0%. The Commission should not use the rounding approach it adopted in the UCLL/UBA decision.

We discuss each of these points in greater detail below.

2.5.1 Problems with use of a simple mean or median

Most of the estimates considered by the Commission change very slowly over time

A significant problem with the Commission's existing TAMRP approach, and the main reason for the stability of the TAMRP estimates, is the Commission's

application of a simple mean and/or median to the estimates from different sources, some of which produce estimates that are effectively constant. Such an approach will tend to result in TAMRP estimates driven primarily by estimates that change very slowly over time, such as the Ibbotson estimates.

The Commission's Ibbotson estimates reflect the average risk premium that investors have actually received from the market, measured over a long historical period. For instance, the Commission's Ibbotson estimate for New Zealand is based on historical excess returns data since 1931.[16] Because it is a backward-looking long-term average, the Ibbotson approach will tend to produce estimates that change very slowly over time. Every additional year that passes provides only one additional data point. In addition, because each new observation is added to a progressively lengthening series of realised excess returns, each new observation receives diminishing weight in the long-term average over time.

The Ibbotson estimates for other markets will tend to be even more stable over time than the New Zealand estimates, because the estimates for other markets tend to be based on even longer time series than is available for New Zealand, and also involves averaging cross-sectionally over several countries. Both of these features will tend to dampen the effect of year-on-year changes of realised returns.

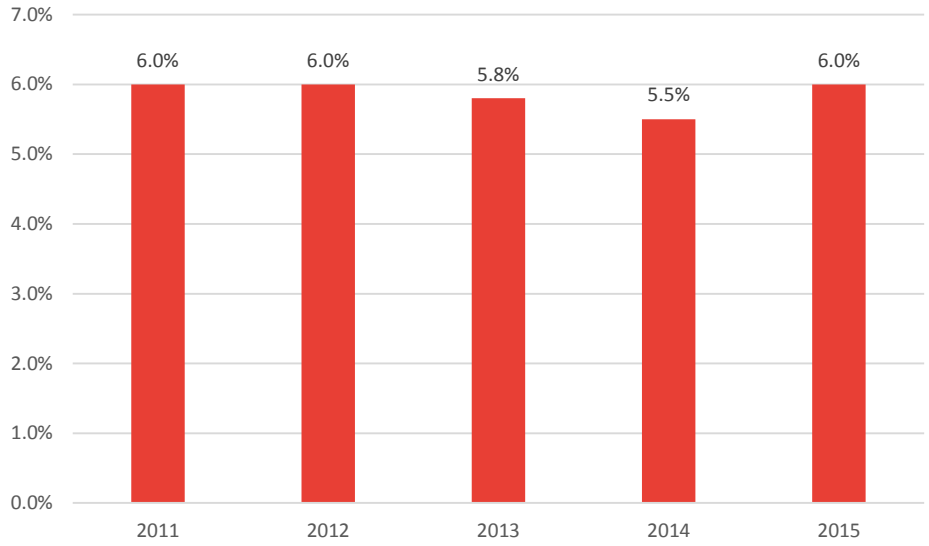
The Siegel 1 approach is a variant of the Ibbotson approach in the sense that the Siegel 1 approach starts with an Ibbotson estimate and makes an adjustment to account for the effect of unanticipated inflation on equity returns. In the case of the Siegel 1 estimates for New Zealand, the data used to derive the adjustment for unanticipated inflation spans the same period used to derive the Ibbotson estimates for New Zealand (i.e., from 1931 onwards). Hence, like the Ibbotson approach, the Siegel 1 approach will also tend to produce little variation in estimates over time.

The survey evidence that the Commission has used in the UCLL/UBA decision is sourced from Fernandez et al (2015). The Commission makes use of the median of responses for New Zealand and for all developed countries surveyed.[17] An examination of the surveys conducted by Fernandez et al in 2015 and in previous years shows that the median MRP estimate for New Zealand changed very little over time (see Figure 4). The stability of the survey estimates over time is likely to be due, at least in part, to the use of a median value across all responses and for the tendency of survey participants to simply report the same estimate every year.

16 Lally (2015), section 7.2.

17 Lally (2015), section 7.5.

Figure 4: Median survey responses on New Zealand MRP over time



Source: Fernandez et al (2015), Table 2; Fernandez et al (2014), Table 4

By contrast to the three approaches above, the Siegel 2 and DGM estimates will generally exhibit significant variation over time. This is because:

- The Siegel 2 approach involves subtracting from a (stable) long-run average market return (expressed in nominal terms using a current inflation forecast) an estimate of the prevailing risk-free rate, which tends to be quite volatile over time.
- The DGM approach uses current market data only. The DGM provides an estimate of the TAMRP by subtracting from an estimate of the prevailing required market return an estimate of the prevailing risk-free rate. The prevailing required market return is derived by equating the present value of expected future dividends with current market prices for equities. The tendency for DGM estimates to be variable over time is because these estimates are based entirely on current market data, and reflect investors' current required returns, which are sensitive to prevailing market conditions. It is the only approach considered by the Commission that reflects current market perceptions about risk in the prevailing market conditions – approaches that consider a long run average will (by definition) reflect the average market conditions over the relevant long-run period.

Problem with mean estimates

In summary, the Commission's overall TAMRP estimate is based on three approaches that produce estimates that tend to change very slowly over time, and two estimates that can exhibit much more variation over time. When the Commission computes the mean across all these estimates, it effectively assigns

equal weight to each approach. This means that the slow-moving estimates (i.e., Ibbotson, Siegel 1 and surveys) receive a collective weight of 60%, and the more variable estimates (i.e., Siegel 2 and DGM) receive a collective weight of 40%.

In the UCLL/UBA decision, the average estimate derived from the Ibbotson, Siegel 1 and survey approaches (for New Zealand and international markets) is 6.50%. Consequently, the Siegel 2 and DGM estimates would need to be, on average, 8.50% or greater for a mean estimate of the TAMRP to exceed 7.25% and not be rounded down to 7.0%.[18] In fact, however, the mean Siegel 2 estimate in the UCLL/UBA decision was only 7.75%. That means, the DGM estimate would need to be, on average, 9.25% or greater for a mean estimate of the TAMRP to exceed 7.25% and not be rounded down to 7.0%.[19]

Problem with median estimates

However, as noted in section 2.4.2, in the UCLL/UBA decision, the Commission did not derive a mean estimate of the TAMRP; it derived a median estimate. A median estimate will tend to entrench the Commission's estimate of 7.0% even more than would a mean estimate. For example, in periods of financial crisis when risk premiums are elevated (and risk-free rates will tend to be low if a flight to quality occurs as happened during the GFC), it will inevitably be the case that the DGM and Siegel 2 methods will produce the highest estimates of the TAMRP, and that the Siegel 1 method (which adjusts down the Ibbotson estimate) will be the lowest. In this case, the median will be determined by the Ibbotson and/or survey approaches, with the DGM and Siegel 2 approaches effectively receiving no weight at all.

In other words, under the Commission's current approach to estimating the TAMRP, the method that would provide the best indication of elevated risk premiums, the DGM approach, would exert the smallest influence on the Commission's TAMRP precisely when risk premiums are high.

The tendency for Ibbotson and survey estimates to determine the Commission's median estimates (and for DGM and Siegel 2 estimates to have no influence at all) has been borne out in the last two major decisions on the TAMRP made by the Commission:

- In the Cost of Capital IM, the median across all the estimates considered by the Commission (7.09%) was determined by the mean of the New Zealand Ibbotson estimate (7.27%) and the US survey estimate (6.90%).
- In the UCLL/UBA decision, the median across all the estimates considered by the Commission (7.05%) was determined by the mean of the New Zealand

18 That is, $0.6 \times 6.50\% + 0.4 \times \underline{8.50\%} = 7.3\%$.

19 That is, $0.6 \times 6.50\% + 0.2 \times 7.75\% + 0.2 \times \underline{9.25\%} = 7.3\%$.

Ibbotson estimate (7.10%) and the Ibbotson estimate for other foreign markets (7.00%).

So, whilst the Commission says that it estimates the TAMRP by considering a range of approaches, in practice, its TAMRP estimates are determined by, at most, two approaches.

In our view, this is clearly a problem, and is one of the principal causes of the implausible TAMRP estimates that the current Cost of Capital IM produces in some market conditions. The solution to the problem (which we spell out in more detail in section 2.6) is for the Commission to weight its estimates according to the characteristics of the estimation techniques, and prevailing market conditions, rather than use median estimates.

Further, we see no good reason why the Cost of Capital IM should fix an estimate for the TAMRP when it does not fix an estimate for the risk-free rate — both these parameters change over time, but only the risk-free rate is updated each time the Commission requires an estimate of the Cost of Capital. At best, such an approach helps reinforce a view that the TAMRP is fixed over time, whereas that is clearly not so; at worst, it removes an opportunity for the Commission to ensure that the TAMRP for every regulatory decision is a realistic reflection of the prevailing market conditions. We recommend that the Cost of Capital IM set out the methodology for estimating the TAMRP, but not specify an estimate; instead, the Commission should apply the Cost of Capital IM to update its TAMRP estimate each time such an estimate is required.

2.5.2 No basis for rounding estimates

As noted in section 2.4.2, in the UCLL/UBA decision, the Commission made explicit its rule of rounding its median estimate of the TAMRP to the nearest 0.5%. In our view, there is no sound economic or regulatory rationale for such a practice. Such a rule ensures that if the median estimate of the TAMRP deviates from the figure of 7.0% the Commission has traditionally used by ±0.25%, the final estimate of the TAMRP will remain 7.0%. Given that the Commission's approach of deriving median estimates will favour slow-moving estimates, it is highly likely that its median estimates will tend to fall within the rounding range. This, in turn, would tend to entrench a value of 7.0%.[20]

In other words, under the approach used by the Commission in the UCLL/UBA decision, the TAMRP applied to suppliers such as Transpower could be 0.25% higher or lower than it would otherwise be, simply due to the Commission's rounding rule. Assuming an equity beta of 0.61 (i.e., the equity beta applied by the

[20] Under the Commission's rounding rule, in order for the overall TAMRP estimate to rise above 7.0%, the median estimate (which, for the reasons outlined above, will tend to be determined by the Ibbotson and/or survey-based estimates) would have to be 7.25% or greater.

Commission to Transpower in the existing Cost of Capital IM), this represents a possible difference in the cost of equity allowance of ±0.15%.[21] In turn, this represents a possible difference in the overall cost of capital allowance of ±0.09%, assuming a gearing level of 44% (i.e., the gearing assumption that the Commission applied to Transpower in the existing Cost of Capital IM).

This may seem a very modest difference. However, in revenue terms, the difference is not trivial because it will generally apply to a large asset base. For example, Transpower's regulatory asset base for 2015/16 is forecast to be $4,610.2 million.[22] This means that a difference in the cost of capital allowance of just ±0.09% would translate into a difference in allowed revenues of over ±$3.9 million per annum (or more than $19.6 million over a five year regulatory period before accounting for the time value of money). A revenue difference as large as this can occur purely because of the arbitrary practice of rounding the TAMRP to the nearest 0.5%. In our view, this is unreasonable to customers and to suppliers.

On these grounds, we recommend that the Commission no longer use the rounding approach it adopted in the UCLL/UBA decision.

2.6 Characteristics of approaches considered by the Commission

A key weakness of the Commission's approach to estimating the TAMRP is the way in which estimates from different approaches and sources are weighted. If the Commission uses a simple mean estimate, it effectively weights estimates from all approaches equally, and nearly all of the approaches it considers are incapable of reflecting market risk during periods of unusual market conditions. If the Commission uses a median estimate, the TAMRP estimate will be determined by, at most, two approaches, which, once again, tend to be incapable of reflecting unusual market conditions; all other approaches effectively receive no weight at all.[23]

The obvious solution is for the Commission to weight estimates from different approaches in recognition of their characteristics and relative strengths. The Commission seems to have a view that all of the approaches have different

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21 That is, ±0.25% × 0.61 = 0.15%.

22 Commission (2014), Table 2.6, p.21.

23 Lally (2015, p.30) argues that "…the fact that a median of five estimator will be one of the five estimators does not imply that it has received 100% weight." We disagree with this argument. If the Commission determines the TAMRP by taking the median of five estimators, only one of those estimators will determine the TAMRP. The remaining four estimators play no role, except to the extent that they determine the ordinal ranking of the estimators and, therefore, which estimator determines the median. The remaining estimators receive effectively no weight in the final estimate of the TAMRP.

strengths and weaknesses, no approach is clearly better, and therefore it should not apply different weights to different approaches:[24]

> Given that the various approaches to estimating TAMRP produce significantly different estimates of TAMRP, and that no approach to estimating TAMRP is generally accepted as superior or free from methodological criticisms, we prefer to place weight on a wide range of estimates (as Dr Lally does), rather than strongly preferring one approach (such as CEG's DGM analysis) over others.

This view has been stated explicitly by the Commission in the past:[25]

> No approach to estimating the TAMRP was considered by the Commission to be necessarily better than any other.

Whilst it is true that the various approaches have different strengths and weaknesses, that is no reason to weight them all equally. Some approaches (e.g., surveys) are inherently less reliable, or amenable to proper interpretation, than others. These approaches should receive little or no weight. Some approaches, owing to their characteristics, will be more or less relevant in certain market conditions, and should be weighted accordingly.

Regulators in the UK have generally taken the approach that the weight given to different evidence on the MRP should reflect the market conditions prevailing at the time of their decisions:[26]

> Typically, we have taken a long term view on the appropriate market risk premium. Dimson, Marsh and Staunton are often cited as a key reference work in this area. However, there is no academic consistency on the appropriate values and we have to exercise judgement based on our analysis and the evidence available. As with the risk-free rate, we consider past, current and future rates and give appropriate weight to each of these depending on the circumstances. The judgement on the appropriate market risk premium to adopt is therefore affected to some extent by the wider financial conditions existing at the time each decision is made.

Indeed, the Commission itself has expressed similar sentiments when it altered its estimate of the TAMRP from 7.0% to 7.5% in an attempt to take account of the effects of the GFC on suppliers' cost of equity:[27]

> The weighting placed on each approach is a matter of judgment for the Commission, which requires taking into account all the available evidence, and current market circumstances. For instance, if due to the GFC the world were considered a more risky place in the medium or longer term, then additional weight may need to be put on forward-looking estimates. Further consideration is given to the GFC later in this section.

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24 Commission (2015 UCLL/UBA), para.192.1.

25 Commission (2010), para. H7.47, p.485.

26 UKRN (2015), para.3.10, p.8.

27 Commission (2010), para. H7.27, p.482.

Therefore, the approach we recommend below does not require a very large departure from the way the Commission has assessed evidence when responding to the GFC. We simply say that it should not require an event as extreme as the GFC for the Commission to weight the approaches according to their relative strengths, and in reflection of prevailing conditions.

Table 4 summarises our views on how the Commission should weight different approaches. We elaborate on this in the sections below.

Table 4: Summary of recommendations on how the Commission should weight approaches

Approach	Comment	Recommendation
Ibbotson	Assumes implicitly a stable TAMRP Capable of providing a reliable TAMRP estimate only when in average market conditions	Ibbotson and Siegel 2 approaches should be viewed as opposite ends of a spectrum, and Commission should have regard to both approaches. The weight attached to each end of the spectrum could be varied depending on prevailing market conditions.
Siegel 2	Assumes implicitly an stable total market return and inverse relationship between TAMRP and risk-free rate Capable of providing a reliable TAMRP estimate when away from average market conditions	
Siegel 1	No sound basis for this approach	Discard altogether
DGM	Capable of providing a reliable TAMRP estimate when away from average market conditions	Give more weight to DGM when away from average market conditions
Surveys	Unreliable and difficult to interpret	Give low weight in all circumstances

Source: Frontier Economics

2.6.1 Ibbotson

As explained above, there is broad agreement that the risk premiums that equity investors require vary over time. That is, the TAMRP is not constant. In some conditions in the market for funds, investors will require a higher premium for bearing equity risk, and in other conditions in the market for funds they will require a lower premium for bearing equity risk. It is this consideration that led the Commission to raise its estimate of the TAMRP by 0.5% temporarily in 2010.

In the Cost of Capital IM, the Commission describes the Ibbotson approach as an ex post, or backward-looking, approach.[28] That is correct because it reflects only returns realised by investors. The mean of historical excess returns is only capable

[28] Commission (2010), para. H7.11, p.479.

of providing an estimate of the long-run average level of the TAMRP – commensurate with the average conditions in the market over the historical period. In other words, because it is a long-run historical average, the Ibbotson approach produces estimates of the TAMRP that investors should expect during average market conditions.[29] Estimates of the TAMRP derived from the Ibbotson approach provide very little information on investors' required risk premiums when market conditions have deviated from average conditions.

Moreover, to the extent that Ibbotson-type TAMRP estimates do vary over time, they will often move in the opposite direction to risk premiums actually demanded by investors. For instance, during financial crises when financial risk premiums are at their highest, stock prices tend to fall materially, causing a small reduction in the historical average. There are some good historical illustrations of this:

- During 2008 and early 2009, global stock markets plummeted. Adding the large negative returns from this period to the existing sample of historical excess returns causes the mean to fall. But in such market conditions, risk premiums are likely to be higher, not lower. Indeed, other things equal, an increase in risk premiums must cause a fall in stock prices, and consequently a fall in the historical mean of excess returns.
- Dimson, Marsh and Staunton, writing in the 2013 Credit Suisse Investment Returns Yearbook, note that in Russia, as a consequence of the 1917 Revolution, the State expropriated nearly all (over 99%, in present value terms) private assets.[30] This represented almost complete losses for domestic bondholders and stockholders. Similarly, in China, following 1949, when the Communist Party came to power, domestic investors experienced complete losses as the government expropriated private assets.[31] These two extreme examples illustrate a very important point. At the time investors in Russia and China were experiencing very large negative returns, risk premiums would have been increasing sharply. Investors would have been demanding higher, not lower, returns to commit funds in those countries. However, the long-run historical average realised excess returns in those countries would have been falling, due to the effect of adding to the long-run average the large negative returns experienced by investors.

The Commission's own advisers in relation to the existing Cost of Capital IM noted this very point:[32]

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29 Average market conditions would be characterised as conditions in which the risk-free rate and risk premiums are close to their long-run means.

30 Credit Suisse (2013), pp.10, 51.

31 Credit Suisse (2013), pp.10, 40.

32 Commission (2010), para. H7.97, p.499.

> The Expert Panel [i.e., Prof Stewart Myers, Prof Julian Franks, Dr Martin Lally] agreed that historical (backwards-looking) estimation techniques do not pick up short-term shocks very quickly, and to the extent that they do recognise them, they will initially, i.e. until a longer term of data affected by the GFC is available, (wrongly) result in lower estimates of the market risk premium as a result of the GFC.

Hence, during average market conditions (i.e., when market volatility and investor risk aversion is at long-run average levels), Ibbotson estimates can provide useful information on the risk premiums required by investors. However, during periods of very high or very low volatility, other approaches (such as the DGM) provide much more useful and timely information on the prevailing TAMRP. As we have set out above, under the approach adopted by the Commission in the UCLL/UBA decision, the Ibbotson approach will tend to either determine entirely (or influence very heavily) the TAMRP estimate **under any and all market conditions**, but produces sensible estimates of the TAMRP in only certain limited circumstances. We do not think this is appropriate.

2.6.2 Siegel 2

If the long-run historical averages derived from the Ibbotson approach are interpreted as the TAMRP, an implication of such an approach would be that the TAMRP is very stable over time (because it is determined by a long-run historical average), while the risk-free rate and total market return move one-for-one in the same direction.[33]

By contrast, the Siegel 2 approach implies that the total real market return demanded by investors is in line with the long-run average historical total market return (which will change very slowly over time). From this rate, the prevailing (tax-adjusted) risk-free rate is subtracted. That would imply that the TAMRP varies over time, and moves inversely with the risk-free rate.

There will be times when the TAMRP will move in the opposite direction to the risk-free rate (e.g., during financial crises, if investors sell out of risky assets and seek out riskless assets, as occurred during the GFC). However, there could also be times when the TAMRP and the risk-free rate move in the same direction. Hence, in our opinion, the Ibbotson and Siegel 2 approaches should be viewed as opposite ends of a spectrum, and the Commission should have regard to both approaches. However, the weight attached to each end of the spectrum could be varied depending on prevailing market conditions. For instance, if there is evidence of a flight to quality occurring, more weight could be attached to Siegel 2 than Ibbotson. In average market conditions, both approaches will produce similar estimates of the TAMRP.

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33 This is because the TAMRP is equal to the total market return less the (tax-adjusted) risk-free rate. Hence, if the TAMRP is largely fixed, but the risk-free rate is varying over time, algebraically, the implied total market return must move in the same direction as the risk-free rate.

2.6.3 Siegel 1

When responding to the Commission's consultation on its Revised Draft UCLL/UBA decision, CEG argued that the Ibbotson and Siegel approaches essentially produce two estimates of the same number:[34]

> From Lally's own presentation of the Ibbotson and Siegel (version 1) estimates, it is clear that these are two alternative measures for a single number – namely the historical average of excess returns relative to 10 year bond rates. The Siegel (version 1) is proposed as a correction to the Ibbotson methodology to adjust for what may, or may not, be an accurate estimate of unexpected inflation over the relevant historical time period. But for this adjustment the Siegel (version 1) estimate is the same as the Ibbotson estimate.
>
> Including both as separate estimates in the sample doubles the weight given to measures based on historical average excess returns. This would be inappropriate even if one considered that these estimates were superior to the other estimates. However, for the reasons set out above, I consider that they are inferior which strengthens the case for combining them into a single estimate. Lally does not state his own opinion as to which is preferable.

In response to CEG's point, Dr Lally says that:[35]

> … whilst these two estimators have considerable overlap in that both use the historical average market returns, the point of distinction between them (the historical average long-term real risk free rate versus an improved estimate of the expected long-term real risk free rate) causes a significant difference in outcomes.

We agree with CEG that Ibbotson and Siegel 1 are essentially two versions of the same estimator. Siegel 1 is simply the Ibbotson estimate with an adjustment to account for unanticipated inflation. If the Commission were to compute a mean estimate of the TAMRP, use of both approaches essentially doubles the weight given to historical average excess returns.

Dr Lally's main response to this point is that, whilst the two approaches both use the historical average market returns, they produce very different estimates. That is true. However, the reason the two approaches produced very different estimates is because the Sieglel 1 estimate involved taking the Ibbotson estimate and making a large downward adjustment. So, of course the two approaches have resulted in divergent estimates. That does not change the fact that the Siegel 1 estimate is simply a variant of the Ibbotson estimate.

The Siegel 1 adjustment for unanticipated inflation ensures that, for the foreseeable future, the Siegel 1 estimate will always be lower than the Ibbotson value. As a result, when the Commission computes a median estimate of the TAMRP, there is a very low probability that Siegel 1 will determine the TAMRP estimate directly.

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34 CEG (2015), paras. 329 and 330, pp.106-107.

35 Lally (2015), p.4.

However, the inclusion of the Siegel 1 approach in the Commission's set of evidence affects the TAMRP estimate indirectly by pushing the Ibbotson estimate up in the ordinal ranking of estimates, thereby increasing significantly the chances that Ibbotson will determine the TAMRP estimate.

Consider, for instance, Table 5, which presents what the Commission's UCLL/UBA estimates would have been had it excluded the Siegel 1 estimates, with all else remaining equal.

Table 5: TAMRP estimates for UCLL/UBA decision if Siegel 1 had been excluded

Approach	New Zealand	International markets
Ibbotson	7.10%	7.00%
Siegel 1	Dropped	Dropped
Siegel 2	8.00%	7.50%
DGM	7.40%	9.00%
Surveys	6.80%	6.30%
Median (unrounded)	**7.25%**	**7.25%**
Median (rounded)	**7.50%**	**7.50%**
Commission's estimate in UCLL/UBA decision	**7.0%**	

Source: Adapted from Commission (2015 UCLL/UBA), Table 4, p.46; Frontier calculations

Dropping the Siegel 1 estimates:

- pushes the median estimate for New Zealand up from 7.10% to 7.25% (i.e., previously determined entirely by the Ibbotson estimate, but now determined by the mean of the Ibbotson and DGM estimates); and
- pushes the median estimate for international markets up from 7.00% to 7.25% (i.e., previously determined entirely by the Ibbotson estimate, but now determined by the mean of the Ibbotson and Siegel 2 estimates).

Under the Commission's rule of rounding to the nearest 0.5%, the overall TAMRP estimate would have been 7.5% rather than 7.0%, which is a material difference.

Notice that, in the case of the median estimate for New Zealand, the inclusion of Siegel 1 meant that the estimate was determined entirely by Ibbotson, whereas the exclusion of Siegel 1 allowed the median estimate to be determined jointly by Ibbotson and DGM, the only estimator that is capable of reflecting investors' prevailing required risk premiums in all market conditions.

As Siegel 1 currently plays the role of nudging the Commission's median estimate of the TAMRP towards the Ibbotson estimate (which, in turn will tend to preserve

the status quo estimate of 7.0%, even when other market evidence suggests that risk premiums have increased or fallen significantly), in our view the Commission should consider very carefully the rationale for including Siegel 1 in its set of evidence. In our view, Siegel 1 should not be used at all.

There are many problems with the Siegel 1 approach as recommended by Dr Lally:

- Firstly, one of the key motivations for the Siegel 1 approach rests on a prediction made by Siegel in the 1990s that future real government bond yields would rise (relative to 1990 levels). This prediction has turned out to be completely wrong — a fact that Siegel (2011) himself has acknowledged recently.
- Secondly, whilst Siegel attributes the low real government bond yields observed since the 1920s to unanticipated inflation, there are several other factors that could have explained those low yields. Whilst Dr Lally fails to consider any explanation apart from unanticipated inflation, Siegel (1992) himself enumerates several possible alternative explanations. One of those explanations, a flight to quality (i.e., away from risky assets to relatively safe government bonds) following financial crises in the early 20th century, is now recognised widely as one of the main reasons that real government bond yields fell sharply during the GFC. It is entirely possible that the role of unanticipated inflation in explaining the low real yields noticed by Siegel was overstated.
- Thirdly, inflation is only one of many other factors that investors probably failed to anticipate. As we explain below, it is not at all clear why the Commission should 'correct' for one example of poor forecasting by investors but not others. Once the Commission starts making ex post adjustments of this kind, any number adjustments could be argued for, and it is very difficult to know where the line should be drawn.
- Finally, it is likely that the correction that Dr Lally applies to the Ibbotson estimate is overstated because he has failed to account for illiquidity premia that are likely within the yields on inflation-protected bonds issued by the New Zealand government. In fact, the Reserve Bank of New Zealand (1997), where Dr Lally sources the data used to compute the Siegel 1 correction, has warned about this very issue.

We discuss each of these points in turn below.

The main prediction supporting the rationale for Siegel 1 has turned out to be wrong

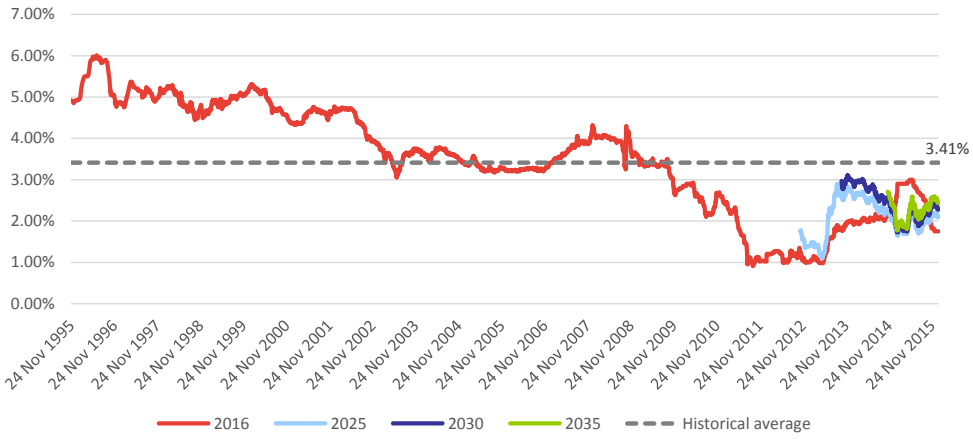
The main reason Siegel gives for arguing that the equity premium observed historically is unlikely to persist in future is based on a prediction that turned out to wrong. Siegel (1999, p.15) states:

> The degree of the equity premium calculated from 1926 is unlikely to persist in the future. The real return on fixed-income assets is likely to be significantly higher than

> that estimated on earlier data. This is confirmed by the yields available on Treasury inflation-linked securities, which currently exceed 4%.

In fact, since Siegel wrote his paper in 1999, real government bond yields in New Zealand have **fallen** significantly, as shown in Figure 5. Indeed, since February 2009 (coinciding with the GFC), the real risk-free rate in New Zealand has been persistently below the historical average.

Figure 5: Yields on inflation indexed New Zealand government bonds



Source: RBNZ Table B2, Frontier analysis

In an article in the wake of the GFC, Siegel (2011, p.144) admits that his prediction that real government bond yields would increase was wrong, as was his assessment that post-war realised bond yields were biased downward:[36]

> Another prediction that did not materialize was my estimate of future bond yields. I believed that the real yields on bonds would remain between 3 and 4 percent, the level that prevailed when Treasury Inflation-Protected Securities (TIPS) were first issued in 1997. I also believed that the realized bond returns in the period after World War II (WWII) were biased downward because of the unanticipated inflation from the late 1960s through the early 1980s. So, I did not consider historical returns on bonds; instead, I used the current yield on TIPS in making my forecast for future bond yields.
>
> Instead, real yields fell dramatically, especially in the wake of the financial crisis. As of early 2011, 10-year TIPS yields are less than 1 percent and 5-year TIPS yields are negative. The two primary reasons for the drop in real yields are the slowdown in economic growth and the increase in the risk aversion of the investing public, which, in turn, is caused by both the aging of the population and the shocks associated with the financial crisis. The decline in inflation has caused the yields on nominal bonds to drop even more, generating very large realized returns for nominal bond investors. Over the last decade, realized bond returns were 4.7 percent per year after inflation,

36 Siegel (2011), p.144.

> swamping stock returns. Over the past 20 years, realized bond returns were 6.0 percent per year, 1 percentage point less than the 7.0 percent real returns on stocks.

In other words, the author of the work that Dr Lally and the Commission rely on to justify the Siegel 1 approach has admitted that a fundamental basis for that approach has turned out to be incorrect.

Siegel (2011, p.147) went on to conclude that his views on the direction of equity risk premiums, and on any 'bias' in those premiums, have been reversed completely:

> Real bond returns are on track to be much lower. Ten-year TIPS are now yielding about 1 percent, so the excess returns of stocks over bonds should be in the 5–6 percent range, which is higher than the historical average. And the bias, if any, will be toward a higher equity premium if real bond yields rise from their extremely low levels, as I think they should. In short, relative to bonds, stocks look extraordinarily attractive, and I expect stock investors will look back a decade from now with satisfaction. [Emphasis added]

There are many alternative explanations for low real yields observed by Siegel

With the benefit of hindsight on the events of the GFC, there are reasons to think that the low real bond yields that Siegel had attributed to unanticipated inflation may have been due, at least in part, to other reasons. As Siegel (2011) notes in the quote above, one of the main causes of the large drop in real yields during and after the GFC was a change in investor risk aversion. In fact, Siegel (1992, p.36) proposed several other factors, apart from unanticipated inflation, that could have explained the post-war decline in real government bond yields. One of the possible explanations proposed by Siegel was high demand for high quality government bonds following major financial crises:[37]

> Perhaps the low real interest rates during much of this century can be explained by a combination of historical and institutional factors. The 1929-32 stock market crash and the Depression left a legacy of fear; most investors clung to government securities and insured deposits, driving their yields down.

A flight to quality during financial crises is well-documented, most recently during the GFC, and is now recognised as a very real phenomenon.

A flight to quality, following major financial crises, would not imply that the real government bond yields had been biased downwards or that risk premium estimates based on long-run historical average excess returns had been overstated.

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[37] Other plausible explanations that Siegel (1992, pp.36-37) proposed, and which Dr Lally has ignored as possible reasons for the low real yields observed by Siegel, and the widening of realised historical excess returns, included: redistribution policies by the government following the Depression; loose monetary policies by the Federal Reserve until the early 1950s; and the development and deepening of bond markets.

Events such as these belong properly in the historical record of excess returns, and contribute to the picture of average risk premiums that investors can expect to demand over the long-run. Scrubbing these periods from the historical record (as Siegel 1 effectively does) distorts the picture of the full range of market conditions that investors can expect to face over the long-run and, therefore, the average excess returns they can expect to earn over that period.

Investors failed to foresee many outcomes, so why focus on inflation?

Even if historical excess returns had been distorted by bondholders systematically underestimating inflation, why should the Commission give this consideration so much weight in its TAMRP estimation? If the Commission starts down the path of making ex post corrections of this kind, there are any number of other corrections that it ought to also consider. For instance:

- It could be argued that financial crises (which tend to push risk premiums up), are likely to become more frequent and more severe over time as financial markets become more integrated, and the risk of systemic failures increase. As markets have become more integrated over time, arguably TAMRP estimates based on historical excess returns would be an underestimate of the premiums that investors will demand in future to compensate them for these growing risks.
- Equity investors in the 1920s could not have anticipated the growth in asset values that occurred due to the technology boom that happened, particularly in the latter half of the 20th century. If so, should historical excess returns be adjusted to account for the fact that most investors historically did not foresee those outcomes? And should we assume that there will be no such technology booms in the future?

There are many other such examples that could be proposed. Once the Commission starts making ex-post adjustments to historical averages for events or phenomena that investors failed to anticipate, it is difficult to know where to draw the line. In our view, it is better to use historical data as they are, rather than attempt (poorly) to estimate what those data would have been if a particular event or phenomena had not occurred.

The Siegel 1 correction is likely overstated as it does not account for likely illiquidity and term premia in inflation-indexed yields

It is likely that the correction that Dr Lally applies to the Ibbotson estimate, to account for actual inflation outstripping anticipated inflation, is overstated because it fails to account for likely illiquidity premia in inflation-indexed yields.

As noted above, Dr Lally applies the Siegel 1 approach by "adding back [to the Ibbotson estimate] the historical average long-term real risk free rate and then

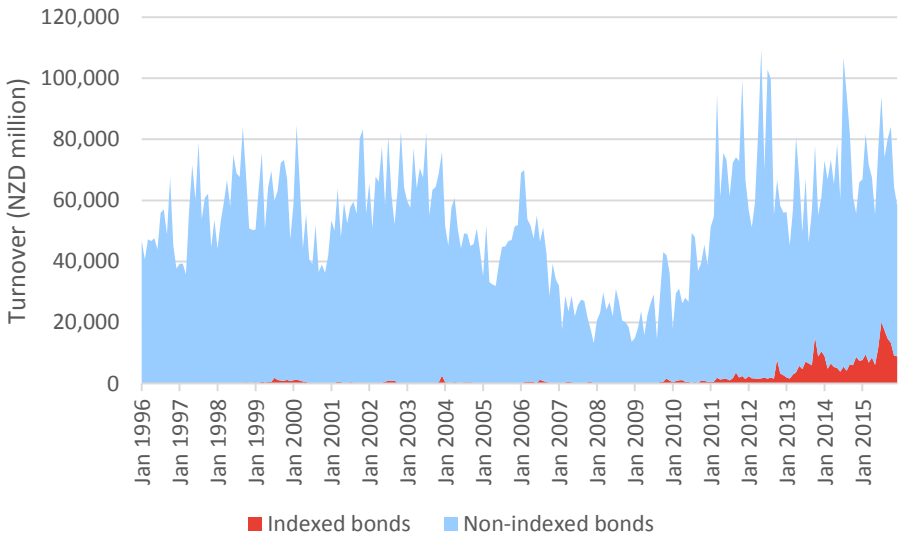
deducting an improved estimate of the expected long-term real risk free rate". Lally and Marsden (2004 Siegel, p.96), who develop this approach, explain that:

> …an improved estimate of the historical average of the expected real bond yield will be drawn from the historical yields on inflation-protected government bonds supplemented with the real yields on nominal bonds for some earlier periods [in which inflation was stable and default unlikely]. The latter are again drawn from Lally and Marsden, and the real yields on inflation protected bonds are drawn from the Reserve Bank [of New Zealand] website.

However, the inflation-protected government bonds that Dr Lally uses to compute the adjustment in the Siegel 1 approach are very thinly traded compared to bonds that are not inflation-protected.[38] This is evident from Figure 6, which plots the total monthly turnover in indexed and unindexed New Zealand.

Figure 7 plots the average monthly turnover of the most long-lived of the inflation indexed bonds available in New Zealand (issued in November 1995 and due to expire in February 2016), and compares this against the average turnovers of two non-indexed bonds with very similar maturity dates (April 2015 and December 2017).[39] Over the period analysed, the non-indexed bonds had between 4.5 and 6.2 times greater turnover than the inflation protected bond.

Figure 6: Monthly turnover in indexed and non-indexed government bonds

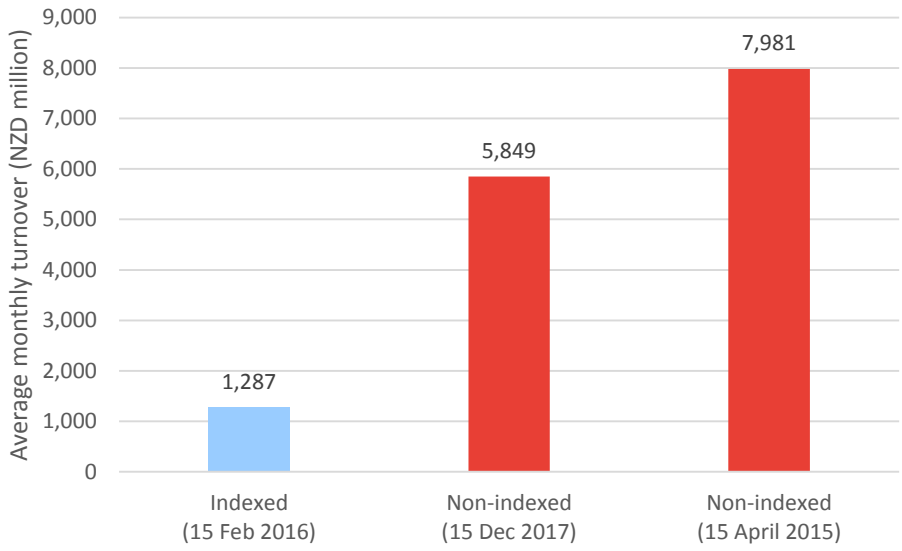


Source: RBNZ Table D9, Frontier analysis

38 The illiquidity of inflation-protected bonds has been noted in markets significantly larger than New Zealand's, e.g., Australia — see RBA (2011, p.8).

39 To make the comparison as fair as possible, Figure 7 plots average monthly turnover for only the period during which all three bonds have existed, April 2005 to April 2015.

Figure 7: Average monthly turnover of selected indexed and non-indexed bonds



Source: RBNZ Table D9, Frontier analysis

Investors in thinly traded bonds will typically demand an illiquidity premium, which would push the yields on those bonds higher than they would otherwise be. Accounting for any such illiquidity premia would widen the observed historical gap between the equity returns and the yields on inflation-protected government bonds. That would imply that the magnitude of Dr Lally's Siegel 1 adjustment to the Ibbotson estimate is overstated.

In fact, the Reserve Bank of New Zealand (where Dr Lally sources the data he uses to implement Siegel 1) has warned on this very issue:[40,41]

> Indexed bonds are usually quite illiquid relative to nominal bonds. If indexed bonds are less liquid, investors may require a higher yield to compensate. Thus, when comparing indexed and nominal bonds to derive inflation expectations, it is important to account for any premium due to differences in the liquidity of each instrument – something which is, of course, particularly difficult to get at.

As far as we can tell, Dr Lally has not made any allowance for the possibility of an illiquidity premium in the observed yields on inflation-protected government bonds. This casts real doubts about Dr Lally's claim that the yields on inflation-protected government bonds represent "an improved estimate of the historical average of the expected real bond yield".

40 RBNZ (1997), p.328.

41 Whilst the comments in this quote relate to problems when deriving an estimate of expected inflation using the rate of inflation implied by observed yields on indexed and unindexed government bonds, the problem identified applies equally when using the yields on inflation-protected bonds to compute excess returns on the market.

2.6.4 DGM

As noted in section 2.4, amongst the various estimation approaches considered by the Commission, the DGM is likely to reflect prevailing market conditions most closely, because the DGM estimates make use of current market prices, as well as current expectations about future dividend streams, as key inputs. This means that DGM estimates are likely to be:

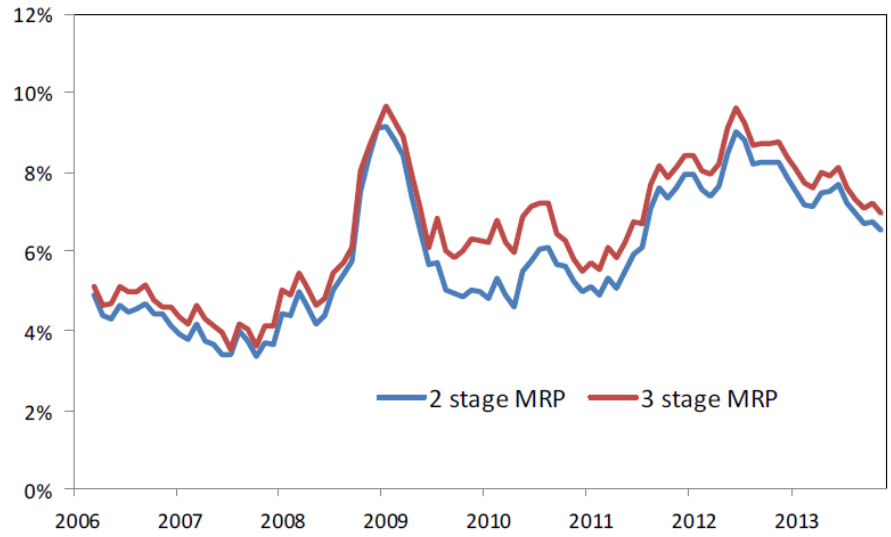
- low when equity investors are demanding low risk premiums;
- similar to Ibbotson estimates when investors are demanding risk premiums close to historical average levels; and
- high when equity investors are demanding high risk premiums.

The ability of the DGM to reflect prevailing market conditions has been acknowledged by other regulators, such as the AER:[42]

> The DGM method is a theoretically sound estimation method for the MRP. As DGM estimates incorporate prevailing market prices, they are more likely to reflect prevailing market conditions.[377] DGM estimates are also clearly forward looking as they estimate expectations of future cash flows and equate them with current market prices through the discount rate.[378]

It is clear when examining DGM estimates over time that they move in the same direction as one would expect risk premiums to move. Consider, for instance, Figure 8, which plots the AER's DGM estimates for Australia over time.

Figure 8: AER's DGM estimates



Source: Bloomberg and AER analysis

42 AER (2013 Appendices), p.84

Source: AER (2013 Appendices), p.118

Figure 8 shows that:

- The estimates are quite low (i.e., around 4.0%) during periods of market stability and low volatility, i.e., the period between 2006 and 2008, when Australia enjoyed a period of sustained economic growth following an unprecedented mining and resources sector boom.
- The estimates are relatively high during periods of high market volatility, i.e., in late 2008 and early 2009, during the peak of the GFC, and then between 2011 and 2013, when global commodity prices collapsed.
- The estimates were at a moderate level (i.e., around 6.0%, which corresponds to MRP estimates for Australia based on long-run average historical excess returns) between 2010 and 2011, when markets had recovered temporarily from the peak of the GFC, and before the commodity prices crashed.

As can be seen from the AER's estimates above, the DGM can provide plausible estimates of the TAMRP, even during periods of unusual or extreme market conditions. This is a very attractive feature of the DGM, which almost none of the other approaches considered by the Commission share. Further, the DGM is likely to produce estimates that are similar to the Ibbotson approach during average market conditions. For these reasons, we recommend that the Commission give primary (but not exclusive) weight to DGM estimates.

In 2010, when the peak of the GFC had passed, the Bank of England undertook a study to understand empirically what drove the decline of equity prices during the crisis. In that study, the Bank of England used the DGM to estimate how risk premiums had changed as a result of the crisis, and this technique was chosen specifically because it is able to provide a good indication of how risk premiums respond to changing market conditions:[43, 44]

> The DDM provides a framework to assess the factors that might account for the observed large movements in equity prices since mid-2007, prior to the start of the financial crisis.

The Bank of England found that estimates of the MRP using the DGM had risen significantly during the peak of the GFC, in 2008 and 2009, to levels similar to those experienced at during the last major financial crisis between 2001 and 2003 (left hand panel of Figure 9). The Bank of England also showed that the DGM estimates of the MRP were broadly consistent with other standard indicators of risk, such as the implied volatility index on the FTSE 100 index (right hand panel of Figure 9).

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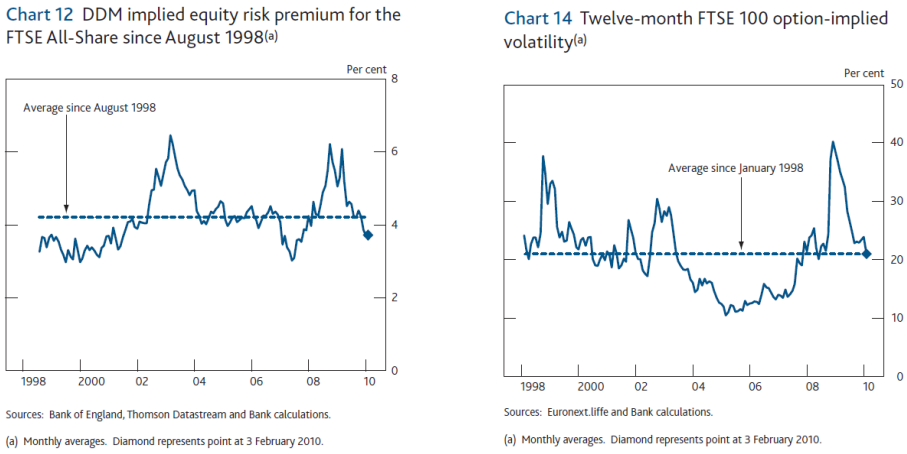
43 Bank of England (2010), p.26.

44 The Bank of England uses the term DDM for Dividend Discount Model – a difference in name only.

Figure 9: Bank of England's DGM estimates and implied volatility index



Source: Bank of England (2010)

2.6.5 Surveys

Survey evidence on the TAMRP can be useful in certain circumstances, if certain conditions are met:

1. The survey must be timely. There must have been no change in the prevailing conditions in the market for funds since the survey was administered and the survey results used for estimation purposes. Essentially, the survey results should not be outdated.
2. There must be clarity about precisely what respondents were asked so that there is no ambiguity about how to interpret their responses. Further, there should be clarity in the wording of the surveys themselves. Very open-ended questions, that leave room for significant interpretation by respondents, are unlikely to illicit consistent and useful results.
3. The survey must reflect the views of the market and not a sample that is small, unresponsive, or with insufficient expertise to answer the questions in an informed manner.

In the UCLL/UBA decision, the Commission relied on a survey by Fernandez et al (2015), which was fairly timely (the survey data were collected between March and April 2015, which was just a few months before the Commission applied those results in its decision). However, when pointing this out, Dr Lally conceded that:[45]

> In respect of timing differences between the survey and the averaging period used by the Commission, this would only be a few months and the survey results clearly do not vary much over time. For example, the median response in 2013 was 5.8%

45 Lally (2015), pp.15-16.

> (Fernandez et al, 2013, Table 2) whilst that for 2015 is 6.0% (Fernandez, 2015, Table 2). Thus, the timing difference is not a significant issue.

In our view, Dr Lally's concession that "the survey results clearly do not vary much over time" reveals a lot about the ability of surveys to reflect timely market expectations about risk premiums. If respondents suggest that risk premiums are very stable over time, as they evidently do (see Figure 4), even when many other market indicators suggest that risk premiums are changing over time, that could suggest survey participants are using outdated information to inform their responses, are displaying inertia for other reasons, or have misinterpreted the questions being asked.

Another possibility is that the way in which the survey responses are interpreted by the Commission leads to inherent stability in the results over time. In the UCLL/UBA decision, the Commission used the median across all responses for New Zealand as its survey-based estimate. Suppose that actual risk premiums had in fact increased significantly, or fallen materially, around the time the survey was conducted. Suppose, further that a few respondents had reflected these developments in their responses, but the majority had not (e.g., they reported a risk premium that they use consistently over time). Taking the median survey response as the overall estimate would effectively discard the responses of those few who had reflected prevailing conditions in their answers (i.e., they would effectively be treated as outliers), so those estimates would have no impact on the evidence set used by the Commission.

In regards the second criterion about clarity, survey responses can be notoriously difficult to interpret. Dr Lally himself appears to agree with this,[46] as did the Commission in the existing Cost of Capital IM:[47]

> Survey evidence can be subjective and difficult to interpret. For example, the results may suffer from non-response bias and questions, no matter how carefully crafted, either might not be properly understood or might not elicit the correct response. These issues might result in an upward or downward bias in responses. An example of this was referred to in advice to the Commission where Dr Lally assessed an estimate of the market risk premium from survey evidence and noted that the results for at least one group (practitioners) may be biased upwards due to some responses mistakenly supplying an estimate of the TAMRP rather than the MRP.[1051]

The questions actually asked of the survey participants by Fernandez et al (2015) are reproduced below in Figure 10.

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46 Lally (2014), p.30; Lally (2015), p.15.

47 Commission (2010), para. H7.24, pp.481-482.

Figure 10: Survey questions asked by Fernandez et al (2015)

Survey Market Risk Premium and Risk-Free Rate 2015

We are doing a **survey** about the **Market Risk Premium** (MRP or Equity Premium) and **Risk Free Rate** that companies, analysts, regulators and professors use to calculate the **required return on equity (Ke)** in different countries.

I would be grateful if you would kindly answer the following 2 questions. No companies, individuals or universities will be identified, and only aggregate data will be made public. I will send you the results in a month.

Best regards and thanks,
Pablo Fernandez. Professor of Finance. IESE Business School. Spain.

2 questions:
1. The Market Risk Premium that I am using in 2015
for USA is: _____ %
for_____ is: _____ %
for_____ is: _____ %
for_____ is: _____ %

2. The Risk Free rate that I am using in 2015
for USA is: _____ %
for _____ is: _____ %
for _____ is: _____ %
for _____ is: _____ %

Source: Fernandez et al (2015), Exhibit 1

In relation to these questions, we note the following:

- Whilst participants are asked to provide the MRP they are using (as opposed to simply their prediction of the MRP), respondents are not asked what they are using their estimates for (e.g., for classroom examples vs. long-term equity investment decisions, where real money is at stake). In our view, the use to which respondents are putting their estimates has some bearing on the reliability of those responses.
- Whilst participants were asked to provide an estimate of the risk-free rate they were using, they were not asked for further details about that risk-free rate estimate (e.g., the term; or whether respondents are pairing a long-run average of the risk-free rate with a MRP determined by long-run historical averages of excess returns, or whether respondents are pairing a contemporaneous estimate of the risk-free rate with a contemporaneous estimate of the MRP, or whether they are mixing and matching). In short, it is impossible to discern whether respondents' view of the MRP is consistent with their view of the risk-free rate.
- No information is sought on the time horizon over which their response relies (or whether the respondents believe there is a term structure for the MRP that is implicit in their answers).
- No information is sought on whether respondents have made any adjustments to their MRP to reflect prevailing market conditions (i.e., an uplift or a markdown), or to address shortcomings of any model that they may be

applying the MRP to.[48] If some respondents have made adjustments within their estimates, and others have not (either because they make such adjustments elsewhere, or because they believe no such adjustments are warranted), that would confound meaningful comparisons between survey responses.

- The survey question does not ask respondents to make clear if their estimates relate to the MRP or the TAMRP (which was the problem identified by the Commission in the quote above). Again, inconsistencies of this kind would make comparisons of survey responses meaningless.

On the final criterion above, Dr Lally notes (in a rebuttal to CEG's criticism that the New Zealand sample of survey responses was small) that the estimate for New Zealand derived from Fernandez et al (2015) was based on 31 responses and, in doing so, seems to imply that this is a sufficiently large sample to derive meaningful estimates.[49] It is unclear on what basis Dr Lally considers 31 responses is not a small sample. Of the 41 countries covered in Fernandez et al (2015, Table 2), it was possible to rank the countries from 1 to 30 in terms of the number of responses collected, with '1' having the most responses, and '30' having the fewest.[50] In this ranking, New Zealand placed just 27 out of 30 (equal with Turkey and Thailand). Furthermore, New Zealand offered just five more responses than the lowest ranked country, Argentina (26 responses in total). By contrast, the top five countries provided several times more responses than did New Zealand: USA (1,983); Spain (443); Germany (252); France (122); UK (101). By these comparisons, it is a stretch to suggest that New Zealand, with its 31 responses, does not represent a small sample, and appropriate caveats to the estimates from New Zealand should be applied.

Finally, we note that no information is provided by Fernandez et al (2015) on the expertise of the respondents, other than a general explanation that they could be "finance and economic [sic] professors, analysts and managers of companies". In our view, the expertise of the survey respondents has some bearing on the reliability of the evidence.

For all the reasons set out above, we consider that survey estimates are among the least reliable of the evidence considered by the Commission, and should therefore receive low weight in the Commission's analysis of the TAMRP.

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48 As noted in section 4.1, there is evidence that some corporate finance practitioners make such adjustments, either explicitly or otherwise.

49 Lally (2015), p.15.

50 In this ranking, we allow countries to be ranked equal in terms of survey responses — hence the lowest rank, 30, is less than the total number of countries surveyed by Fernandez et al (2015).

2.7 Indicators of prevailing market conditions

In the sections above, we have proposed that the Commission should weight the different approaches to estimating the TAMRP according to:

- their relative strengths (e.g., the DGM approach should be given primary weight, unreliable approaches such as surveys should be given very little weight, and the Siegel 1 approach should not be used); and
- prevailing market conditions (e.g., the weight given to the Ibbotson and Siegel 2 estimates should depend on whether the financial markets are away from long-run average conditions).

In order to implement this recommendation, the Commission would need a method for tracking prevailing market conditions.

In 2013, IPART, the economic regulator in New South Wales, Australia, developed (using a set of well-known market uncertainty indicators) an 'uncertainty index', and a clear decision rule on how this index could be used to vary weights applied to different approaches. We do not suggest that IPART's methodology should necessarily be transplanted into the Cost of Capital IM. However, we offer the example of IPART to illustrate that it is feasible to use market indicators and other evidence to assess prevailing market conditions, and then weight estimates using different approaches accordingly. Furthermore, the example of IPART shows that such an approach is being applied by another regulator, albeit in a more formal manner than is perhaps necessary for New Zealand. In this section we discuss briefly IPART's approach and outline how a simpler version of that approach could be adopted by the Commission.

2.7.1 IPART's new approach to estimating the cost of capital

In December 2012, IPART initiated a fundamental review of its cost of capital methodology. The impetus for that review was a concern from IPART that its old cost of capital methodology (which shares a number of features with the Commission's existing Cost of Capital IM) was, in the wake of the GFC, no longer fit for purpose. At the conclusion of that review, in December 2013, IPART published the details of its new cost of capital methodology.[51]

The new methodology included a number of major departures from its old approach. One of the main changes was a recognition by IPART that its old approach to estimating the cost of equity involved a deep inconsistency that had been exposed by the GFC. Specifically, under the old approach, IPART used to estimate the cost of equity using the SLM-CAPM by coupling:

[51] IPART (2013).

- An estimate of the prevailing risk-free rate (calculated by taking a 20-day average of yields on Commonwealth Government Securities as close as practicable to the commencement of the regulatory period); with
- An estimate of the MRP, based on long-run historical average excess returns, which was typically fixed at 6% in all determinations.

These features are very similar to the approach set out in the Commission's existing Cost of Capital IM. IPART was concerned that this approach was leading to nonsensical estimates of the cost of equity because, essentially, these estimates would move in lock-step with changes in the risk-free rate. In the context of large falls in Australian government bond yields, during and after the peak of the GFC, IPART's old approach implied that equity capital was cheaper than ever before.

Following this realisation, and after extensive consultation with stakeholders, IPART introduced a new approach, which involved:

1. **Deriving an estimate of the cost of equity using only current market data**, whereby a contemporaneous estimate of the risk-free rate (computed by taking a 40-day average of prevailing government bond yields) would be coupled with a contemporaneous estimate of the MRP (computed using a range of techniques, several of which are versions of the DGM).
2. **Deriving an estimate of the cost of equity using only long-run historical averages**, whereby a long-run risk-free rate (computed by taking a 10-year historical average of government bond yields) is coupled with a MRP reflecting long-run historical excess returns (typically 6%).
3. **Using these two separate estimates to form the upper and lower bounds of a cost of equity range.**
4. **Selecting a point estimate from this range by reference to an 'uncertainty index' developed by IPART.**

The uncertainty index is constructed by combining four, quite highly correlated but separate indicators of market uncertainty that are used widely by practitioners and in the finance literature. The four indicators selected by IPART were:

- **An implied volatility index.** IPART adopted the S&P/ASX 200 VIX, an index that reflects the market's expected volatility in the S&P/ASX 200 stock index. This volatility index is used commonly in Australia to monitor the expected level of short-term volatility in the Australian stock market.
- **Dispersion in analysts' forecasts for companies in the S&P/ASX 200**. Academic studies use the dispersion of analysts' forecasts of earnings for listed companies as an indicator of uncertainty about future earnings. Generally, the more widely dispersed are forecasts, the greater is the uncertainty in the market; the greater the consensus amongst analysts, the less uncertainty in the market.

- **Credit spreads.** Credit spreads (i.e., the difference in the observed yield on risky bonds, less the risk-free rate) are an indicator of the creditworthiness of borrowers. A market-wide measure of credit spreads provides a market-determined indication of investors' perceptions of the likelihood of default.
- **Spread between the 3-month Bank bill rate and the 3-month overnight index swap (OIS).** The Bills-OIS spread is a measure of the liquidity of the interbank lending market, and is used more widely as an indicator of the liquidity of credit markets, as well as counterparty default risk.[52]

IPART combined these four measures into a single index that was normalised to a mean of zero, with a standard deviation of one.[53] It then applied the following decision rule:

- If the uncertainty index is within or at one standard deviation from the long-term average of zero, IPART will select the midpoint of the cost of capital range.
- If it is not, has deviated from the mean of zero by more than one standard deviation, IPART will consider deviating from midpoint of the cost of capital range.
- When deciding whether and by how much the cost of capital point estimate should deviate from the midpoint of the range, IPART will have regard to the value of the uncertainty (as well as additional financial market information).

2.7.2 Lessons from IPART's approach for New Zealand

IPART applied this approach to estimate the whole cost of equity. However, it is possible to think of IPART's approach as allowing separate weighting of estimates of the MRP that reflect prevailing market conditions (DGM estimates, predominately) and estimates based on long-run historical averages (e.g., Ibbotson). IPART's approach could be adapted to New Zealand by emulating this aspect.

Specifically, the Commission could use the types of indicators underlying IPART's uncertainty index, and other financial market information, to assess whether

52 During the peak of the GFC, owing to fears of widespread defaults among financial institutions, banks refused to lend to one another, and the interbank lending market shut down. Given the interconnectedness of the whole financial system, a tightening or closure of this market is generally a good indicator of market risk. As the interbank lending market faltered, the price of borrowing in that market, indicated by variants of the Bills-OIS spread, soared.

53 IPART used a technique known as principal component analysis to combine these measures into its uncertainty index.

prevailing market conditions are close to average market conditions, or whether market conditions have deviated materially from average levels.[54]

We note that the Commission has already done something akin to this, when considering how different evidence on the TAMRP should be weighted, in the wake of the GFC. Specifically, it examined the changes in the S&P500 equity index before, during and immediately following the peak of the GFC, as well as the S&P500 VIX, as indicators of the level of market risk and, therefore, the TAMRP.[55]

2.8 Conclusion

Our main conclusions in relation to the Commission's approach to the TAMRP are the following:

- There is very compelling evidence that the risk premium demanded by equity investors varies over time. However, since 2004 the Commission has consistently (except for a brief period between 2010 and 2011) determined a fixed number for the TAMRP of 7.0%.
- The Commission's policy of holding the TAMRP fixed has not produced sensible outcomes. The Commission's CAPM estimates of the cost of equity have effectively tracked movements in government bond yields, which have declined to all-time lows since 2009. As a result, the approach codified in the existing Cost of Capital IM would have implied, during the worst financial crisis since the Great Depression, that equity capital has never been cheaper.
- Whilst the Commission considers estimates derived using different approaches, and those estimates display a reasonable degree of variation, the Commission keeps arriving at the same estimate of the TAMRP, 7.0%. A key reason for this is because the Commission's approach to assessing the empirical evidence on the TAMRP has a tendency to entrench the traditional estimate:
  - Most of the approaches the Commission considers produce estimates that move very slowly over time (i.e., Ibbotson, Siegel 1 and surveys). If the Commission computes a mean estimate of the TAMRP, estimates from the few approaches that vary more with prevailing market conditions (i.e., DGM, Siegel 2) would generally have to be implausibly high to move the Commission away from its traditional estimate of 7.0%.

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54 Other financial market information that the Commission could consider includes (but need not be restricted to): debt and equity transaction data; interest rate swap rates and credit default swap margins; equity analyst reports and independent valuation reports; and analysis by the RBNZ and other central banks on risk premiums. For a discussion on some of these types of evidence, see IPART (2013 Final), section 8.2.3.

55 Commission (2010), pp.504-506.

- If the Commission computes a median estimate of the TAMRP, during periods when prevailing market conditions deviate significantly from average market conditions, the ordinal ranking of estimates will generally mean that slow-moving estimates (e.g., Ibbotson and/or surveys) will determine the final estimate of the TAMRP (and estimates from all other sources will generally be discarded). Again, this will tend to result in persistent estimates of 7.0%.
- Finally, the Commission's policy of rounding TAMRP estimates to the nearest 0.5% also makes it very difficult for the overall estimate to deviate from a figure of 7.0%. There is no economic or regulatory rationale for rounding estimates in this way, but this practice can have a non-trivial impact (upwards, or downwards, depending on the direction of rounding) on revenues.

- We recommend that the Commission no longer compute simple mean or median estimates of the TAMRP, and no longer round estimates to the nearest 0.5%.
- Instead, we recommend that the Commission weight approaches according to their relative strengths, and according to prevailing market conditions:
  - Ibbotson and Siegel 2 estimates have useful information to contribute, and should be viewed as opposite ends of a spectrum. In our view, the default setting (i.e., in the absence of evidence to the contrary) should be to attach equal weight to these two approaches. However, when the Commission is estimating the TAMRP, if there is extraneous evidence that the total return on equity required by investors is similar to the historical average, relatively more weight should be given to the Siegel 2 estimate. If, on the other hand, there is extraneous evidence that shows that risk premiums have increased (relative to historical average levels), relatively more weight could be given to the Ibbotson estimate.
  - The Dividend Growth Model (DGM) offers the best prospects for estimating prevailing equity risk premiums, because the main inputs to the model are current asset prices and prevailing dividend forecasts. Empirically, the DGM has tended to produce high estimates during times when market indicators suggest that investors have demanded high risk premiums, and low estimates during times when market indicators suggest that investors have demanded low risk premiums. The DGM also tends to produce estimates consistent with Ibbotson during average market conditions. If the Commission wishes to derive estimates that reflect risk premiums in prevailing market conditions, it should give primary (but not exclusive) weight to the DGM.
  - Siegel 1 is essentially a variant of Ibbotson. Hence, if the Commission computes a mean estimate of the TAMRP, it would be giving double

weight to the same underlying evidence. If the Commission computes a median estimate, because Siegel 1 estimates will typically sit below Ibbotson estimates, Siegel 1 plays the role of nudging the Ibbotson estimates towards the middle of the ranking of estimates, thereby increasing significantly the likelihood that the Ibbotson estimates will determine the Commission's overall TAMRP estimates.

- A key prediction crucial to the validity of Siegel 1 (i.e., that real government bond yields would rise from levels seen in the late 1990s, and remain high) has been comprehensively proved wrong. In our view, there is no sound basis for Siegel 1, and the Commission should not use this approach when estimating the TAMRP.
- Survey evidence has several major shortcomings and is inherently less reliable than all of the other approaches considered by the Commission. Survey evidence should be given minimal weight by the Commission.

- The Commission should not lock in a TAMRP figure into the Cost of Capital IM. Rather, the Commission should re-estimate the TAMRP, according to a methodology set out in the Cost of Capital IM, each time such an estimate is required. Doing so would increase the chances of the TAMRP estimate reflecting prevailing market conditions — particularly if the recommendations we have outlined above are implemented.

3 Beta estimation

The Update Paper indicated that the Commission would like to receive submissions on the impact on beta estimates of choosing different reference days when measuring stock and market returns, and the impact on beta estimates of different estimation windows.[56] This section addresses these two issues and, in addition, a third technical issue in relation to beta estimation that we raised in our August 2015 report: suitable filters to identify illiquid stocks.

3.1 Reference day sampling errors

3.1.1 Evidence from the empirical finance literature

The Update Paper indicates that the Commission intends to estimate betas using both weekly and monthly returns observations. When estimating betas using returns data of lower than daily frequency (e.g., weekly or monthly returns data), it is necessary to choose the reference day used to calculate returns (e.g., in the case of weekly data, Monday-to Monday, Tuesday-to-Tuesday, etc.).

The resulting beta estimates can be highly sensitive to the reference days selected. The risk of estimation error due to choice of reference day is known in the empirical finance literature as **reference day risk**. Acker and Duck (2007), who investigated the extent of reference day risk associated with five-year monthly betas for S&P500 companies using Datastream data, show that the effect of reference day risk can be very severe. For example, they found that:

- the estimated beta of one stock was +2 using one reference day and -2 using another;
- between two consecutive five-year periods, the estimated beta of one stock fell by 0.93 using one reference day and rose by 3.5 using another;
- the average difference in the beta estimate (arising from a change in the reference day used to measure returns), across all stocks in the sample, ranged between 0.70 and 0.92, depending on the five-year estimation window considered.

Dimitrov and Govindaraj (2007) confirm the findings of Acker and Duck using a different dataset (i.e., CRSP). They found, for instance, that one stock in the sample had a monthly beta estimate of 0.38 using one reference day and 2.45 using another (a difference of +2.08), over the same estimation period. In that study, the mean difference in estimated betas (across all stocks), arising from a change in the reference day used to measure monthly returns, was +0.68, which Dimitrov

56 Update Paper, para. 2.10.1.

and Govindaraj note is similar to the mean range found by Acker and Duck (i.e., 0.70 to 0.92).

3.1.2 Evidence from the Commission's dataset

We investigated empirically the problem of reference day sampling errors by examining the beta estimates underlying the Commission's existing Cost of Capital IM.

In the Cost of Capital IM, the Commission derived beta estimates for 79 comparators, using data over the following time periods and observation intervals:

- Five year period to 31 May 1995 using weekly and monthly observations;
- Five year period to 31 May 2000 using weekly and monthly observations;
- Five year period to 31 May 2005 using weekly and monthly observations;
- Five year period to 31 May 2006 using weekly and monthly observations;
- Five year period to 31 May 2007 using weekly and monthly observations;
- Five year period to 31 May 2008 using weekly and monthly observations;
- Five year period to 31 May 2009 using weekly and monthly observations; and
- Five year period to 31 May 2010 using weekly and monthly observations.

For each comparator, the Commission estimated an asset beta from monthly returns and an asset beta from weekly returns, based upon an average of (up to) eight asset beta estimates relating to each five-year period.[57] The Commission computed an average asset beta estimate across all comparators from the monthly data (0.28) and the weekly data (0.32), and then reported an average across the beta estimates from the two returns intervals (0.30).[58] For the purposes of demonstrating the effect of sampling error arising from the choice of reference days, we analyse only the estimates derived using weekly returns data.[59]

In the existing Cost of Capital IM, the Commission does not report the reference days used to compute the returns series that are then used to derive its beta estimates for each comparator. This is seems to be because the Commission sourced its equity beta estimates for each comparator directly from Bloomberg,[60]

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57 The average asset beta estimates for each firm based upon monthly and weekly returns are presented by the Commission (2010) in Table H18, pp. 521 to 523.

58 Commission (2010), para. H8.63, p. 524.

59 In general, the magnitude of the sampling errors increases as the frequency of the observations used to compute returns falls. In other words, the problem of the reference day sampling errors tends to become more severe as we move from weekly beta estimates to monthly beta estimates.

60 Commission (2010), para. H8.49, p. 519.

and Bloomberg does not disclose as a matter of course the reference day it uses to compute the returns series used in its estimation process.

We obtained share price and market index data directly from Thomson Datastream and used this to compile weekly returns series for every possible reference day (i.e., we compiled a series of Monday-to-Monday returns, Tuesday-to-Tuesday returns, …, Friday-to-Friday returns).[61] We then used these five sets of returns series to estimate, for each comparator, a Monday beta (i.e., a beta estimated using the Monday returns series), a Tuesday beta (i.e., a beta estimated using the Tuesday returns series),…, a Friday beta (i.e., a beta estimated using the Friday returns series).

Table 6 reports the range of variation in beta estimates that arises simply by changing the reference day used. Specifically, the table reports, for a particular comparator (as well as the average across all comparators) the largest beta estimated using any possible reference day minus the smallest beta estimated using any other possible reference day. The table shows that some very substantial changes in the estimated betas for individual comparators are possible simply by varying the reference day selected. For example, in the 1996 to 2000 sample period, the estimated equity beta of one comparator changed by ±3.08 by choosing one reference day over another. In the 2003 to 2007 sample period, the estimated equity beta of one comparator changed ±1.22 by choosing one reference day over another. On average (i.e., over all comparators) in that same sample period, the variation possible in the estimated equity beta was ±0.27. In most of the sample periods considered by the Commission, the average variation in the beta estimate across comparators was ±0.15 or greater.

Table 7 presents the average asset betas over the most recent sample period considered by the Commission in its existing Cost of Capital IM (i.e., the five year period to 31 May 2010) under different choices of reference days.

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61 In many countries, a number of alternative market indices are available. As the Commission has obtained its beta estimates directly from Bloomberg, rather than deriving the estimates itself, it has no choice over the market index used in the estimation exercise, and the indices used are not disclosed in the Cost of Capital IM. In this report, we have used the S&P1500 index (and Datastream's TOTMKUS index in any periods the S&P1500 is not available) when deriving beta estimates for US comparators. We use the FTSE All Shares index when deriving estimates for UK comparators. We use the ASX 200 Total Return Index (and the ASX All Ordinaries index in any periods in which the ASX 200 index is unavailable) when deriving estimates for Australian comparators. Finally, we use the NZX50 Index (and the Datastream TOTMKNZ index in any periods in which the NZX50 Index is unavailable) when deriving estimates for New Zealand comparators. We select these indices as they are the broadest (and therefore most representative) indices available in each of the four markets.

Table 6: Differences in estimated weekly equity betas arising from change in reference day used

	Period 1 1991 to 1995	Period 2 1996 to 2000	Period 3 2001 to 2005	Period 4 2002 to 2006	Period 5 2003 to 2007	Period 6 2004 to 2008	Period 7 2005 to 2009	Period 8 2006 to 2010
Comparators with largest range	0.68	3.08	0.79	1.05	1.22	0.31	0.54	0.44
	0.52	0.54	0.67	0.91	1.03	0.27	0.31	0.31
	0.40	0.52	0.51	0.63	0.87	0.26	0.30	0.27
	0.34	0.36	0.47	0.60	0.73	0.25	0.29	0.26
Comparators with smallest range	0.05	0.04	0.08	0.10	0.11	0.08	0.06	0.05
	0.05	0.04	0.08	0.09	0.10	0.08	0.05	0.04
	0.05	0.04	0.08	0.09	0.08	0.07	0.05	0.04
	0.04	0.04	0.05	0.07	0.07	0.07	0.03	0.03
Mean over all comparators	0.15	0.19	0.21	0.27	0.27	0.14	0.16	0.15

Source: Datastream data; Frontier calculations

Notes: The figures in this table represent, for any given comparator, the largest beta estimated using any possible reference day minus the smallest beta estimated using any other possible reference day. Hence, these figures indicate the range of variation in beta estimates possible for a given comparator simply by changing the reference day used. The estimates in this table are derived using the 79 comparators used by the Commission in the existing Cost of Capital IM, and (apart from varying of reference days) using the same estimation methodology employed in the Cost of Capital IM.

Table 7: Sensitivity of asset beta estimates to reference day selected

Reference day used	Average asset beta estimate over 2006 to 2010 sample period
Monday	0.37
Tuesday	0.34
Wednesday	0.36
Thursday	0.39
Friday	0.38
All reference days	**0.37**

Source: Datastream data; Frontier calculations.

Note: The asset betas in this table have been computed using the 79 comparators adopted by the Commission in the Cost of Capital IM and (apart from varying of reference days) using the same estimation methodology employed in the Cost of Capital IM.

In order to see how sensitive the cost of capital estimate can be to the selection of reference day, note from Table 7 that if Tuesday were chosen as the reference day, over the sample periods considered by the Commission the estimated asset beta would have been 0.34 (rounded to two decimal places). However, if instead Thursday were chosen as the relevant reference day, the estimated asset beta would have been 0.39 (rounded to two decimal places). This represents a difference of approximately 0.05 in the estimate of the asset beta, and a difference of 0.09 in the estimate of the equity beta, assuming gearing of 44% (i.e., the gearing assumption that the Commission adopted for in the existing Cost of Capital IM). In turn, this flows through to a 0.63% difference in the cost of equity, assuming the 7% TAMRP adopted in the Cost of Capital IM. Equity carries 56% weight in the overall allowed return so this implies a 0.35% difference in the WACC.

In short, the allowed return could be ±0.35% merely due to the arbitrary selection of the reference day used to compute weekly returns.

For brevity, we have restricted our example to the analysis of betas estimated using only weekly returns. In general, the magnitude of the sampling errors increases as the frequency of the observations used to compute returns falls. In other words, the problem of the reference day sampling errors tends to become more severe when moving from weekly beta estimates to monthly beta estimates. This is partly because the choice of possible reference days increases as monthly returns are substituted for weekly returns, and therefore the scope for random error introduced by variation in the reference days also increases, and partly because a five-year sample period of monthly returns contains far fewer observations than a five-year sample period of weekly returns.

3.1.3 Solution

As we explained in our August 2015 report, one easily-implementable way to improve the reliability of beta estimates is to first conduct the beta estimation exercise using all available reference days of the week (for weekly returns) or all available reference days for computing four-weekly returns (a standardised version of the monthly return). Specifically, this will mean that weekly beta estimates are compiled five times, using Monday-to-Monday returns, Tuesday-to-Tuesday returns and so on.[62]

Having derived beta estimates using all possible reference days, these estimates could be averaged to derive an overall estimate. Doing so would typically cancel out some of the noise in the beta estimates associated with sampling error introduced by picking one set of reference days over another set, thus producing more precise beta estimates.

As Table 7 shows, the estimated asset beta under this approach (over the 2006 to 2010 sample period) would be 0.37.

It is important to note that the refinement to the Commission's existing methodology that we suggest will not bias the estimates in any particular direction — i.e., it will not tend to push the estimates up or down systematically. Rather, the approach we suggest would simply reduce the influence of sampling error on the overall beta estimates.

3.2 Choice of estimation window

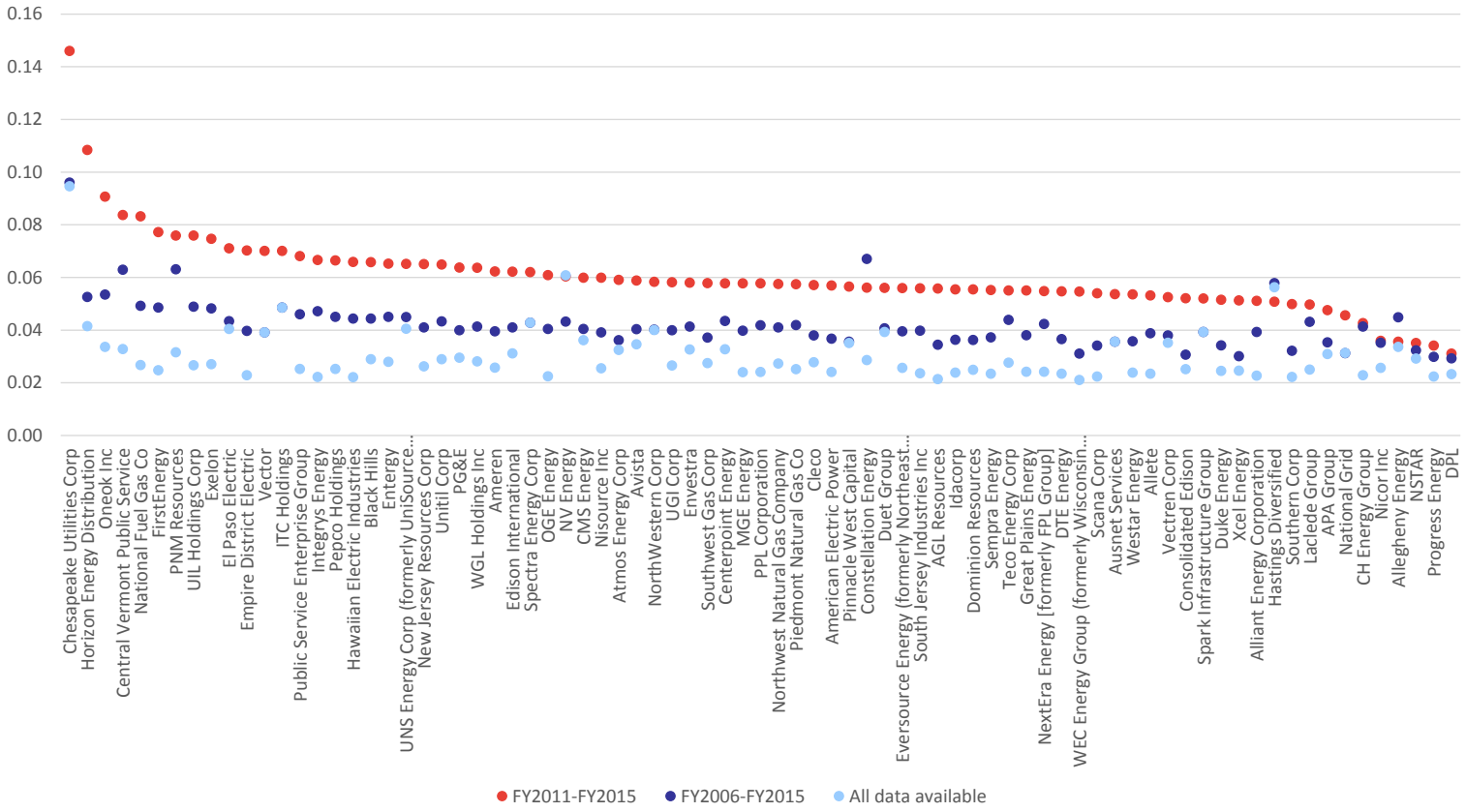
As noted above, in the current Cost of Capital IM, the Commission uses five-year estimation windows when estimating beta. The Update Paper sought views on whether specific time periods should be used when estimating beta.

Whilst using relatively short estimation windows, such as five years, is a reasonably common practice among commercial data services, there is no conceptual reason why the estimation window should be restricted to five years. However, there are good reasons (supported by empirical evidence) why the Commission should also consider estimates derived using the longest sample periods possible.

Firstly, in general, increasing the number of observations within the sample period will increase the statistical precision of the estimates, because a greater number of observations provides more information with which to infer the true relationship between individual stock returns and market returns. Lengthening the sample period permits the inclusion of more observations.

62 Analogously, monthly beta estimates would be compiled by deriving beta

Figure 11: Impact of lengthening sample period on standard errors of beta estimates



Source: Datastream data, Frontier calculations

The fact that the statistical precision of beta estimates increases as the estimation window is lengthened is demonstrated in Figure 11. Figure 11 plots the standard errors of the beta estimates for each of the comparators in the Commission's sample using estimation windows of three different lengths:[63]

- The five years to 31 May 2015;
- The 10 years to 31 May 2015; and
- All data available for each comparator up to 31 May 2015.

The standard error measures the statistical precision of the beta estimate; the lower the standard error, the greater is the precision of the estimate. Figure 11 shows that in almost every case the standard error of the beta estimate declines as the sample period is increased (i.e., the red dots are typically higher than the dark blue dots, which, in turn, are typically higher than the light blue dots).

Secondly, there is empirical evidence that the ability of beta estimates to predict future stock returns increases systematically with the length of the estimation window. Gray et al (2009) estimate the equity beta for stocks in the Centre for Research in Finance database of Australian listed companies at 31 December each year from 1979 to 2003 (1,717 companies altogether), using stock returns from 1958 to 2003. The authors computed the beta estimates by performing Ordinary Least Squares regressions of monthly stock returns versus market returns, where the estimation window ranged from four to 45 years.[64] Next, the authors formed equal value portfolios of high, medium and low beta stocks. Finally, the authors computed the expected returns for each of these portfolios (using the estimated betas of the individual companies), and compared these expected returns against realised returns. One of the key findings from the study was that, in every case, the longer the sample period used to estimate betas, the lower the deviation between CAPM-predicted returns and realised returns. The authors concluded that using all available returns data in beta estimation reduces the imprecision of expected returns estimates derived from the CAPM.

For the reasons outlined above, we recommend that the Commission at least consider beta estimates derived using all the historical data available, rather than restrict the estimation window to five years.

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63 In order to make the comparison of standard errors across these three sample periods as fair as possible, we estimate weekly betas using same reference day (i.e., Friday) in each case. In addition, Figure 11 includes only those comparators that have data available for the full period (i.e., from 2 February 1973 to 31 May 2015).

64 For beta estimates relating in 1979, the longest estimation window is 21 years, which increases to 45 years for the 2003 estimates.

3.3 Liquidity filters

The current Cost of Capital IM recognises that some of the comparators in the Commission's sample used to estimate beta may be thinly traded, and this could affect the beta estimates. To be precise, the inclusion of thinly traded stocks will tend to introduce a downward bias in the overall beta estimate.[65] This is because beta is a measure of the sensitivity of company returns to changes in market returns. In stocks that are traded infrequently, new market information affects the stock price with some lag.[66] As a result, the stock return will appear less sensitive to changes in market movements than it ought to, and this effect will manifest as a lower beta estimate. This effect is essentially due to type of error in measuring stock returns accurately.

The Commission deals with this problem by removing the smallest firms from its sample, i.e., by eliminating any comparators with a market capitalisation less than of US$100 million. This is a blunt way of dealing with the illiquidity of potential stocks as it ignores the possibility that some small companies may be relatively deeply traded, and some large companies may be relatively thinly traded. As we noted in our August 2015 report, there are better ways of taking account of the potential risks of illiquidity.[67]

An established liquidity metric is that presented by Amihud (2002), which takes account of the volatility of the recorded stock price and the dollar volume of daily trade. Amihud's liquidity metric is calculated as follows:

$$Amihud\ liquidity\ metric = \frac{\Sigma \frac{Daily\ absolute\ stock\ return}{Daily\ dollar\ volume\ of\ stock\ traded}}{Number\ of\ days\ for\ which\ a\ trade\ is\ recorded}$$

The smaller this ratio, the more liquid the stock in question is indicated to be.

Figure 12 below plots the Amihud metric for all 79 of the comparators in the sample used by the Commission in the existing Cost of Capital IM using the daily returns data, as well as weekly returns data measured using every reference day possible. Whilst it is possible to compute the Amihud metric for each of the eight sample periods considered by the Commission, in order to provide a more complete picture of how liquid each of the comparators are, the ratios presented in Figure 12 make use of all the data available on each of the comparators.

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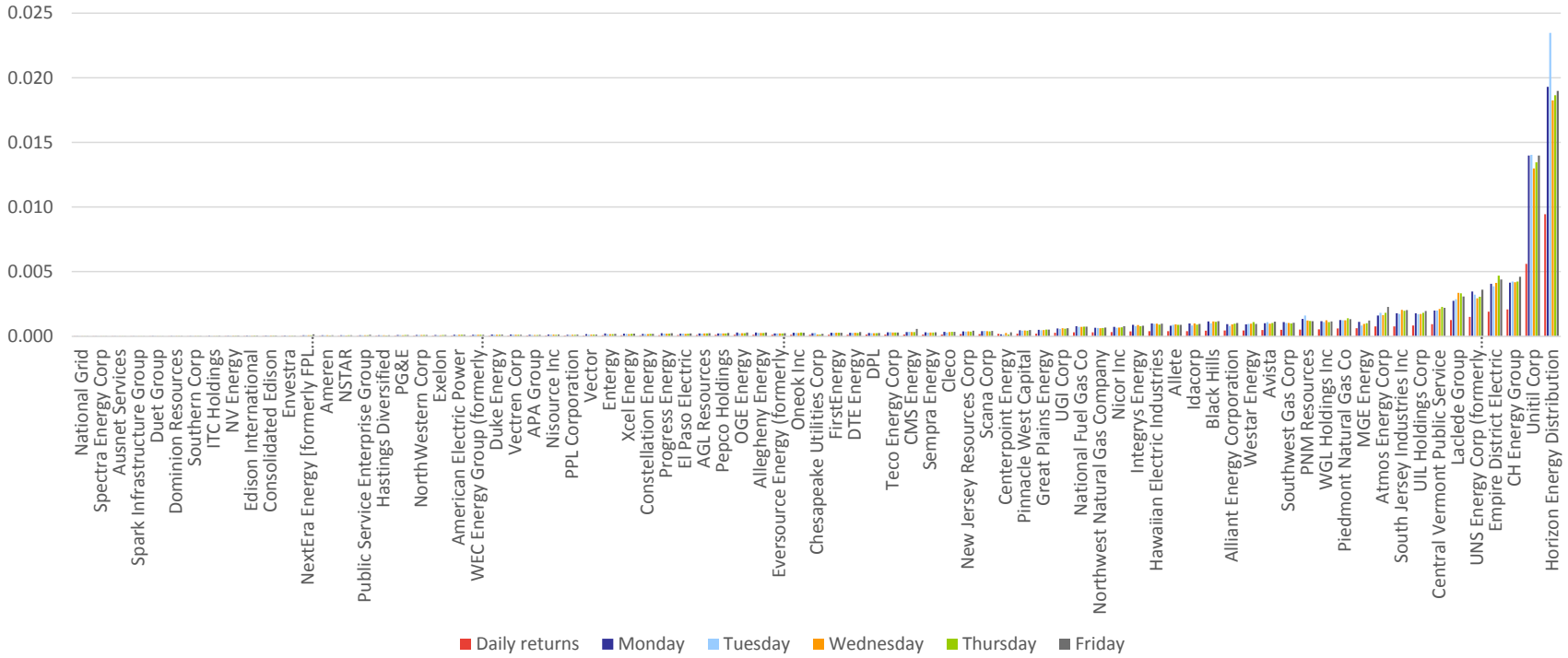
65 See, for instance, Dimson (1979).

66 More precisely, the new information will affect the *value* of the stock immediately, but that will not be observed in the *price* of the stock until the next time the stock trades.

67 Commission (2010), para. H8.44.

Figure 12: Amihud liquidity metric for comparators considered by Commission using all trading data available



Source: Datastream data; Frontier calculations

Beta estimation

Figure 12 shows that the Amihud metric was quite similar for most comparators in the Commission's sample. However, there were a few comparators whose ratio was significantly higher than most others in the sample.

No liquidity indicator used by practitioners or in the finance literature, including the Amihud metric, have an objective threshold that separates liquid stocks from illiquid stocks. Therefore, we devise a test whereby a comparator is considered illiquid if its Amihud measure is greater than a subjective threshold that we specify in advance. We then vary this threshold, between a value of 0.0015 (relaxed) to 0.00025 (stringent) to investigate which, if any, comparators were identified consistently as being illiquid. Table 8 below identifies:

- Any comparator in the Commission's sample whose Amihud metric falls below the threshold specified (column 1);
- The number of periods in which data existed on the comparator (column 2); and
- The proportion of sample periods (considered by the Commission in the Cost of Capital IM), in which data on the comparator was available, that the comparator in question failed to meet the threshold specified — i.e., the proportion of times the comparator was flagged as illiquid (columns 5 to 8).

As one would expect, the table shows that the proportion of sample periods in which a comparator failed to meet the liquidity test increased as the threshold was made more stringent. At the most relaxed threshold we considered (i.e., 0.0015), we found:

- Four comparators (i.e., Horizon Energy Distribution, Central Vermont Public Service, Unitil Corp and Centerpoint Energy) were identified as illiquid in three of the eight (i.e., 37.5%) sample periods the Commission considered and in which data on those comparators existed;
- An additional three comparators (i.e., MGE Energy, Atmos Energy and Laclede Group) were identified as illiquid in two of the eight (i.e., 25%) sample periods the Commission considered and in which data on those comparators existed;
- Horizon Energy Distribution was identified as illiquid in seven of the eight sample periods considered by the Commission; and
- Unitil Group was identified as illiquid in all of the sample periods considered by the Commission.

Table 8: Proportion of sample periods a comparator failed Amihud test

Comparator	No. periods	Threshold applied					
		0.0015	0.00125	0.001	0.00075	0.0005	0.00025
Horizon Energy	8	87.50%	87.50%	87.50%	87.50%	100.00%	100.00%
Allete	8	0.00%	0.00%	0.00%	0.00%	12.50%	25.00%
Alliant Energy	8	0.00%	0.00%	12.50%	12.50%	12.50%	25.00%
Avista	8	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%
Black Hills	8	12.50%	12.50%	25.00%	25.00%	25.00%	37.50%
Central Vermont	8	37.50%	50.00%	75.00%	100.00%	100.00%	100.00%
CH Energy Group	8	0.00%	0.00%	12.50%	25.00%	100.00%	100.00%
Cleco	8	0.00%	0.00%	0.00%	0.00%	12.50%	25.00%
El Paso Electric	7	0.00%	0.00%	0.00%	0.00%	0.00%	28.57%
Empire District Electric	8	12.50%	12.50%	25.00%	25.00%	25.00%	62.50%
Hawaiian Electric	8	0.00%	0.00%	0.00%	0.00%	0.00%	12.50%
Idacorp	8	0.00%	0.00%	0.00%	0.00%	12.50%	25.00%
MGE Energy	8	25.00%	25.00%	25.00%	50.00%	75.00%	100.00%
PNM Resources	8	0.00%	0.00%	0.00%	0.00%	0.00%	12.50%
UIL Holdings Corp	8	0.00%	0.00%	0.00%	0.00%	25.00%	100.00%
UNS Energy Corp	8	12.50%	12.50%	12.50%	12.50%	12.50%	37.50%
Unitil Corp	8	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Westar Energy	8	0.00%	0.00%	0.00%	0.00%	0.00%	12.50%
AGL Resources	8	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%
Atmos Energy Corp	8	25.00%	25.00%	25.00%	25.00%	25.00%	37.50%
Centerpoint Energy	8	37.50%	37.50%	37.50%	37.50%	37.50%	37.50%
Chesapeake Utilities	8	0.00%	12.50%	12.50%	12.50%	12.50%	12.50%
Laclede Group	8	25.00%	25.00%	25.00%	37.50%	62.50%	100.00%
National Fuel Gas Co	8	0.00%	0.00%	0.00%	0.00%	0.00%	12.50%
New Jersey	8	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%
Nicor Inc	8	0.00%	0.00%	0.00%	0.00%	0.00%	25.00%
Northwest Natural Gas	8	0.00%	0.00%	12.50%	12.50%	25.00%	62.50%
Piedmont Natural Gas	8	0.00%	0.00%	0.00%	0.00%	12.50%	25.00%
South Jersey	8	0.00%	0.00%	0.00%	12.50%	25.00%	37.50%
Southwest Gas Corp	8	0.00%	12.50%	12.50%	12.50%	25.00%	50.00%
Vectren Corp	7	0.00%	0.00%	0.00%	0.00%	14.29%	14.29%
WGL Holdings Inc	8	0.00%	0.00%	0.00%	0.00%	12.50%	25.00%

Source: Frontier calculations

Beta estimation

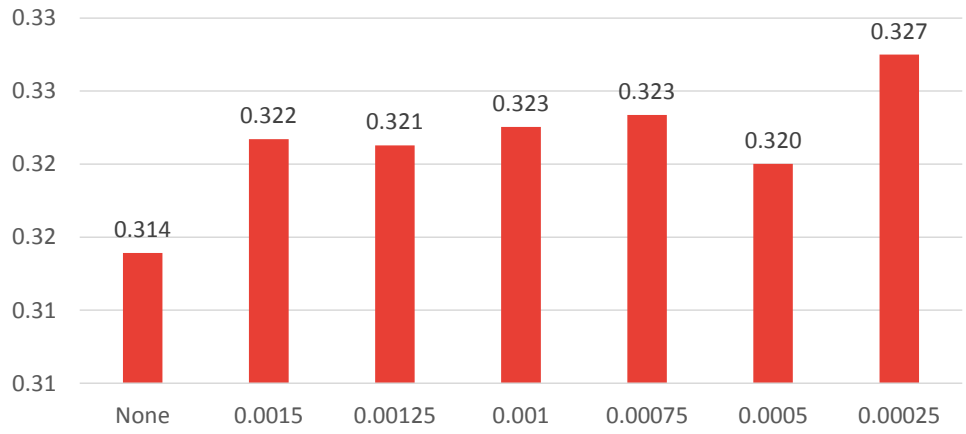
By contrast, under the Commission's approach of excluding any comparator with a market capitalisation less than of US$100 million:

- Horizon Energy Distribution would have been excluded in all eight sample periods; and
- Unitil Group and Chesapeake Utilities Corp would have been excluded in only the 1991-1995 sample period.

In other words, the Amihud metric has flagged several comparators as potentially illiquid that the Commission's size filter did not identify.

The exclusion of firms identified as illiquid can have a material impact on betas estimated and, ultimately, allowed revenues. Figure 13 plots the mean estimated asset beta (averaged over all eight periods considered by the Commission), excluding any comparator identified by the Amihud metric as illiquid in any period, under different liquidity threshold values.

Figure 13: Impact of excluding comparators identified by the Amihud metric as illiquid



Source: Datastream data; Frontier calculations

Notes: Asset betas computed using Friday as the reference day and otherwise using the same estimation approach employed by the Commission in the Cost of Capital IM.

The estimated asset beta if no liquidity filter were applied would be 0.314. If, instead, a liquidity threshold of 0.001 were applied (which is reasonably relaxed), the estimated asset beta would increase to 0.323. Assuming a gearing level of 44% (per the Commission's assumption for Transpower in the Cost of Capital IM), this difference in the asset beta would translate into a difference in the equity beta of approximately 0.02. This, would result in a difference in the cost of equity estimate of approximately 0.11% (assuming a TAMRP of 7.0%), and a difference in the estimated cost of capital of 0.06%. When applied to the regulatory asset base

forecast for Transpower in 2015/16, $4,610 million,[68] a difference in the cost of capital of +0.06% would mean an increase in allowed revenues (relative to the scenario in which no Amihud filter were applied) of approximately $2.8 million per annum (or approximately $14 million over a five year regulatory period, before accounting for the time value of money).

3.4 Conclusion

Our main conclusions in respect of the Commission's approach to beta estimation are the following:

- Because the Commission derives beta estimates using weekly and monthly returns data, and because these estimates are based on a single reference day (for each of those two returns frequencies), the Commission's estimates may be prone to significant estimation error arising from selecting one reference day over others. This type of sampling error is referred to in the empirical finance literature as reference day risk.
- Reference day risk can be reduced significantly by deriving estimates using every possible reference day, and then averaging over all of those estimates. Such a process will tend to cancel out some of the random sampling errors introduced into the estimates by favouring one reference day over others.
- The Commission's current approach uses five year sample periods to when estimating betas (i.e., betas are estimated using returns computed over a five year historical window). There is nothing special about five years. However, the finance literature has shown that the lengthening the sample period increases the statistical precision of estimates. Further, empirical evidence in the finance literature shows that the ability of beta estimates to predict future stock returns increases as the estimation window is lengthened. This implies that all available historical data should be used when estimating betas.
- The beta estimates of illiquid stock are known to be biased downwards. In the existing Cost of Capital IM, the Commission attempts to filter out illiquid comparators by applying a very blunt rule: any comparators with a market capitalisation less than $100 million are dropped. This size filter fails to recognise that some small comparators can be liquid, and some large comparators can be thinly traded. There are better liquidity filters that take account of volatility and volume of trade, rather than relying on size being an indicator of illiquidity. We have applied the Amihud metric and have identified some comparators as potentially illiquid, which the Commission's approach failed to identify.

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68 Commission (2014), Table 2.6, p.21. Companion paper to final determination of Transpower's individual price-quality path for 2015-2020, 28 November 2014.

4 Use of other models to improve the SLM-CAPM

In our August 2015 report, we recommended that the Commission move away from exclusive reliance on the (Simplified Brennan Lally version of the) Sharpe-Lintner-Mossin Capital Asset Pricing Model (SLM-CAPM) and, instead, implement the Fama-French model, and the Black CAPM, as approaches to estimating the cost of equity, **in addition to** the SLM-CAPM.[69]

In its Update Paper, the Commission considered that:[70]

> …there is limited value in undertaking substantive analysis in the IM review of alternatives to using the SBL-CAPM as the main underlying model used to estimate WACC.

To be clear, the Commission's current position on this issue (as embodied in the existing Cost of Capital IM) is not that the SLM-CAPM should be the "main underlying model" used to estimate the cost of equity.[71] Under the existing Cost of Capital IM, the SLM-CAPM is the only model to be used when estimating the cost of equity.

As we explained in our August 2015 report, there are well-known empirical problems associated with the SLM-CAPM, one of which is a tendency for the CAPM to systematically under-predict the returns of low-beta stocks, and over-predict the returns of high-beta stocks.[72] This result has never been overturned in any sound empirical study, of which we provided several examples in our August 2015 report.[73]

The evidence on the SLM-CAPM's tendency to under-predict the returns of low-beta stocks and over-predict the returns of high-beta stocks is now so well-accepted that it appears in standard finance textbooks, as illustrated in Figure 14.

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69 Throughout this report, when we refer to the Commission's use of the SLM-CAPM, our comments relate to the Commission's use of the Simplified Brennan Lally version of the SLM-CAPM, which the Commission refers to as the 'SBL-CAPM'.

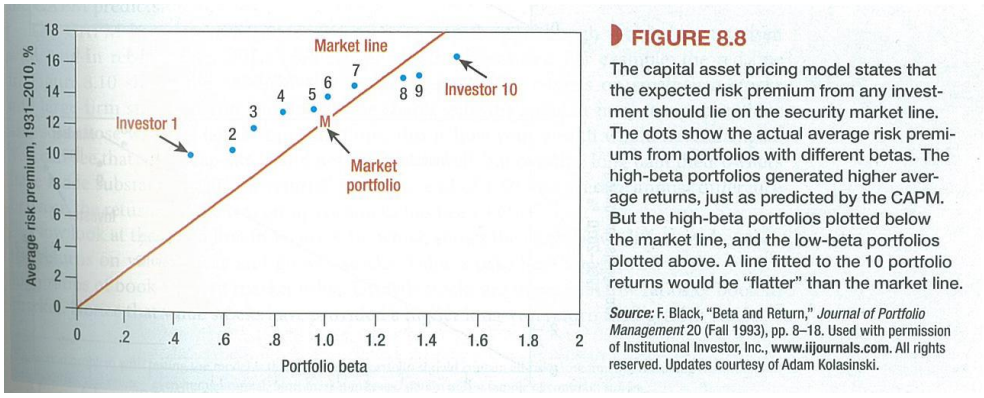
70 Update Paper, para 4.24.

71 In other words, it is not the case that at present the Commission has regard to a range of models when estimating the cost of equity, but places primary weight on the SBL-CAPM.

72 Another example is the tendency for the SLM-CAPM to systematically under-predict the realised returns of stocks with high book-to-market ratios. As we explained in our August 2015 report, the Fama-French three-factor model may be used to correct this bias. To keep the discussion focussed, we concentrate in this report on the low-beta bias issue. However, in our view, correction of the high book-to-market ratio bias using the Fama-French model would also be appropriate.

73 Friend and Blume (1970); Black, Jensen and Scholes (1972); Fama and MacBeth (1973); Fama and French (2004); Lewellen, Nagel and Shanken (2010); Brealey, Myers and Allen (2011); Da, Guo and Jagannathan (2012). See also Section 2 of SFG (2014 Black).

Figure 14: Empirical relationship between excess returns and beta



Source: Brealey, Myers and Allen (2014), p.201.

One of the authors of the textbook from which Figure 14 is derived, Professor Stewart Myers, was an adviser to the Commission when it was developing the existing Cost of Capital IM. Professor Myers noted in his advice to the Commission:[74]

> … average returns for low-beta firms tend to be higher than predicted by the CAPM.

Further, we explained in our August 2015 report that the Black CAPM can be used to correct the SLM-CAPM's low-beta bias. This is because, relative to the SLM-CAPM, the Black CAPM posits a 'flatter' relationship between expected returns and beta (see Figure 15).

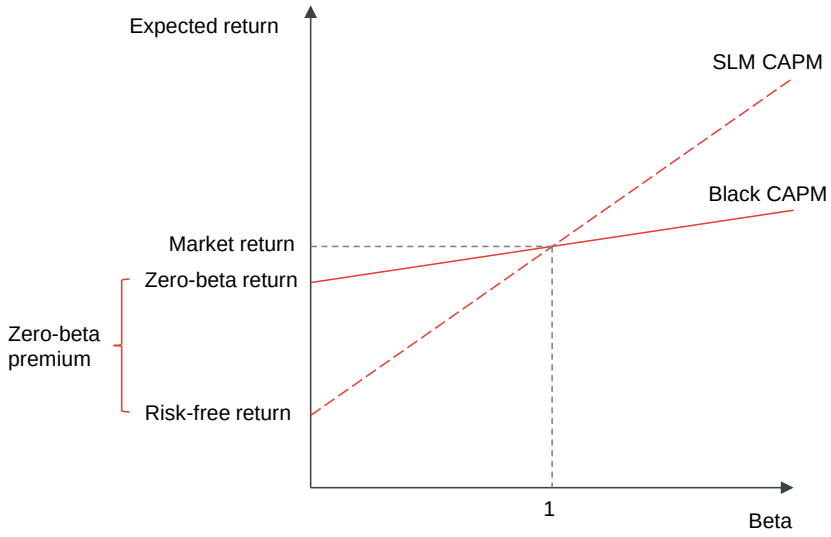
As the market portfolio, by definition, has a beta equal to 1 and earns the market return, the Black CAPM has a higher intercept (i.e., the 'zero-beta return') than does the SLM-CAPM (i.e., the risk-free rate). The difference between the zero-beta return and the risk-free rate, referred to sometimes as the zero-beta premium, represents the correction for the low-beta bias of the SLM-CAPM.

Given the well-known empirical problems associated with the SLM-CAPM (including the low-beta bias), and the availability of other models that can be used to address those problems, it seems unreasonable to us that the Commission should have no regard to those other models and, instead, place exclusive reliance on the SLM-CAPM which is known to have systematic faults.

74 Franks, Lally and Myers (2008), para.44.

Use of other models to improve the SLM-CAPM

Figure 15: SLM-CAPM vs. Black CAPM



Source: Frontier Economics

In this section, we explore the main objection the Commission has expressed for rejecting the other models — i.e., that there is little evidence that the other models are being used by corporate finance practitioners and regulators. We then explain how, with only a minor change to the existing Cost of Capital IM, the Commission could continue to use the SLM-CAPM, but use evidence from the Black CAPM to inform its implementation of the SLM-CAPM in a way that improves the empirical performance of that model.

4.1 Use of other models by practitioners

One of the main reasons given by the Commission for its rejection of models other than the SLM-CAPM is limited evidence that market participants or advisers use those other models in practice. For instance, in the existing Cost of Capital IM the Commission states:[75]

> The CAPM is the most widely understood and most widely used method for estimating the cost of equity in New Zealand, and by regulators in Australia, the UK, and Europe. Whilst alternative models exist, they are rarely used in practice (including in a regulatory context) and have their own shortcomings, including an extensive ongoing debate about their theoretical basis, and the difficulties in sourcing reliable data required by the other models. Due to its strong theoretical foundations, its simplicity and its greater acceptance, the CAPM is preferred by the Commission.

75 Commission (2010), para. 2.43, p.405.

Further, in the Update Paper the Commission states:[76]

> The Black CAPM was primarily rejected when setting the original IMs due the lack of support seen for its use in New Zealand and the fact that we were provided with no clear evidence of its superiority compared to the SBL-CAPM.

The apparent lack of use of other models by practitioners can be explained. Many corporate finance practitioners state that their initial reference point is some form of CAPM, but they then make adjustments that are often consistent with the evidence from alternative models. See, for instance, the results of a 2013 SFG Consulting survey of Australian corporate finance practitioners (Box 1 below),[77] or the findings of Poterba and Summers (1995), who survey CEOs of Fortune 1,000 firms in the US and find that most use hurdle rates that are well in excess of standard estimates of the cost of capital.

Box 1: Adjustments made by Australian finance practitioners to CAPM estimates

In 2013, SFG Consulting (now part of Frontier) conducted a study for the Energy Networks Association in Australia, which examined how independent corporate finance experts, providing commercial valuation advice, had derived their cost of capital estimates.[78] The study examined 29 independent expert reports published between 1 January 2012 and 26 April 2013, which provided a detailed description of the methodology used by the experts to derive their cost of capital estimates. A number of the expert reports in SFG Consulting's sample included valuations of multiple projects. As a result, the 2012/13 sample of 29 reports yielded 34 separate assessments of the cost of capital.

The study found that:

- All of the assessments conducted by the independent experts used the CAPM as the starting point when estimating the cost of equity.
- In none of the assessments was the CAPM implemented mechanistically by adopting the contemporaneous government bond yield as the estimate of the risk-free rate and adding a risk premium equal to the long-run historical average.
- Roughly half of the assessments used an estimate of the risk-free rate that is in excess of the contemporaneous government bond yield and/or used an estimate of the required return on the market that implies a market risk premium in excess of the historical average of excess returns.
- Roughly half of the assessments applied a specific uplift factor to increase the estimate of the required return on equity. In other words, these assessments in fact implement a model other than the CAPM to correct for perceived shortcomings in CAPM estimates. A common reason given for applying these uplifts was that the one-factor CAPM does not account for all relevant risk factors.
- The average adjustment (i.e., over and above the CAPM-based estimate of the cost of equity) applied by the independent experts in the 2012/13 sample was approximately 3%.

Source: Frontier Economics; SFG Consulting (2013 IE)

76 Update Paper, para. 4.19.

77 Owing to the time limits to prepare this report, we have not been able to undertake a similar study of New Zealand corporate finance experts.

78 These commercial valuation services related to proposed corporate transactions including takeover bids, mergers and schemes of arrangement, acquisitions, divestitures, share buybacks, and related party transactions in Australia.

Use of other models to improve the SLM-CAPM

Finally, in our view, the methods used by practitioners to estimate the cost of equity should not necessarily guide the approaches followed by regulators. Graham and Harvey (2001) have conducted one of the most well-known surveys of corporate finance practice in the US. They find that whilst nearly 74% of 392 CFOs surveyed used the CAPM, when estimating the cost of capital, over half may be applying the CAPM-based estimates incorrectly (i.e., by applying a firm-wide discount rate to evaluate a new investment project, even though different projects are likely to have different risk characteristics).

4.2 Use of the Black CAPM by regulators

The Commission also suggests that there is little evidence that the other models, including the Black CAPM, are being used in any meaningful way by regulators.[79] As we explain below, this assessment is not accurate.

4.2.1 Use of the Black CAPM by North American regulators

It is common for US regulatory cases to use what is known as the 'empirical CAPM' (ECAPM) or the 'zero-beta CAPM'. This is an implementation of the CAPM formula with an intercept above the contemporaneous risk-free rate, which is consistent with the Black CAPM and the empirical evidence that supports it. Table 9 provides some examples of regulatory decisions by the New York Public Service Commission and the Oregon Public Utilities Commission that have made use of zero-beta CAPM estimates (usually alongside SLM-CAPM estimates).

In addition, an expert report by Professor J. Robert Malko (Utah State University), which was submitted to the Australian Energy Regulator (AER), noted that evidence on the ECAPM has been presented to, and considered by, regulators in several States, including: California, Colorado, Delaware, Kentucky, Maryland, Michigan, Minnesota, Mississippi, New York, South Dakota, Virginia, Washington and West Virginia.[80] Professor Malko notes that regulators have typically considered ECAPM estimates alongside estimates from the SLM-CAPM and the Dividend Growth Model (DGM).

Finally, a 2013 study by the Brattle Group notes that the Mississippi Public Service Commission and the Alberta Utilities Commission in Canada have included the ECAPM as one of the models used to determine the cost of equity.[81]

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79 Update Paper, para. 4.20.

80 Malko (2015), p.7.

81 Brattle (2013), footnote 38.

Table 9: Examples of US regulatory decisions that have used Black CAPM evidence

Regulator	Industry	Reference	Date
New York Public Service Commission	Electricity distribution	Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service; Petition for Approval, Pursuant to Public Service Law, Section 113(2), of a Proposed Allocation of Certain Tax Refunds between Consolidated Edison Company of New York, Inc. and Ratepayers 2009 N.Y. PUC LEXIS 507	2009
New York Public Service Commission	Gas distribution	Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of National Fuel Gas Distribution Corporation for Gas Service 2007 N.Y. PUC LEXIS 449; 262 P.U.R.4th 233	2007
New York Public Service Commission	Gas & electricity distribution	Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Central Hudson Gas & Electric Corporation for Electric Service; Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Central Hudson Gas & Electric Corporation for Gas Service 2006 N.Y. PUC LEXIS 227; 251 P.U.R.4th 20	2006
Oregon Public Utility Commission	Electricity distribution	In the Matter of PacifiCorp's Proposal to Restructure and Reprice its Services in Accordance with the Provisions of SB 1149 2001 Ore. PUC LEXIS 418; 212 P.U.R.4th 379	2001

Source: LexisNexis

4.2.2 Consideration of Black CAPM evidence by Australian regulators

In Australia, regulators such as the AER, the Economic Regulation Authority (ERA) of Western Australia and the Independent Pricing and Regulatory Tribunal (IPART) have undertaken major cost of capital methodology reviews that have considered whether and how evidence from the Black CAPM can be used when estimating the cost of equity. All of these reviews have occurred since the original Cost of Capital IM was published, so represent an advance on the Commission's thinking since 2010.

Other Australian regulators, such as the Queensland Competition Authority (QCA), the Essential Services Commission (ESC), the Essential Services Commission of South Australia (ESCOSA) and the Office of the Tasmanian Economic Regulator (OTTER) have not investigated the use of the Black CAPM in any serious way. In fact, most of these regulators have not undertaken fundamental reviews of the cost of capital methodologies recently. Hence, the fact that those regulators are not presently using the Black CAPM should not be taken as an indication of their disapproval of the Black CAPM.

All three Australian regulators that have considered seriously the use of the Black CAPM have concluded that the Black CAPM could be used to inform the choice of the SLM-CAPM beta estimates.[82]

AER

For example, the AER states in the Explanatory Statement to its 2013 Rate of Return Guideline:[83]

> Theoretical principles underpinning the Black CAPM suggest the standard Sharpe–Lintner CAPM may underestimate the return on equity for firms with equity betas below 1.0. Although it is difficult to ascertain the magnitude (or materiality) of this effect, selecting a point estimate at the higher end of the range is an appropriate approach to allow for the theoretical differences between the Sharpe–Lintner CAPM and the Black CAPM.

The AER went on to say:[84]

> Under our approach, we adopt a point estimate for equity beta from the top of the empirical range. This is consistent with the point estimate proposed in our equity beta issues paper. We consider a point estimate from the top of the range to be consistent with alternative evidence international equity beta estimates and the theory behind the Black CAPM for the following reasons:
>
> - Theoretically, under the Black CAPM, firms with an equity beta below 1.0 should have higher returns on equity than what the standard Sharpe–Lintner CAPM predicts.[273] This is because, as a result of different starting assumptions, the Black CAPM predicts the slope of estimated returns will be flatter than for the standard Sharpe–Lintner CAPM.[274] This information informs our proposal to select a point estimate at the top end of the 0.4–0.7 range of empirical estimates.

The Commission notes in its Update Paper that one of the reasons the AER rejected the use of the Black CAPM as a fundamental model to estimate the cost of capital was because of the difficulties in obtaining a robust estimate of the zero-beta premium. That was indeed the case when the AER was preparing its Rate of Return Guideline. At that time, the AER had before it a single set of estimates of the zero-beta premium produced by NERA. The empirical methodology used by NERA resulted in an estimate of the zero-beta premium that was approximately 12%, which was almost double the AER's estimate of the market risk premium at that time. The AER considered this estimate to be implausibly large, and the AER's comments in the Rate of Return Guideline about the difficulties in

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82 The Commission's Update Paper notes that the AER has concluded that the Black CAPM has some value as a secondary piece of evidence when estimating the cost of equity for Australian energy networks service providers. The Update Paper did not acknowledge that the ERA and IPART had also concluded that the Black CAPM can assist when estimating the cost of equity.

83 AER (2013), p.86

84 AER (2013), p.88.

obtaining robust estimates of the zero-beta premium were directed squarely at the NERA estimate.

Subsequently SFG Consulting (now part of Frontier) produced separate estimates of the zero-beta premium (using an empirical methodology that improves on NERA's), which resulted in estimates of the zero-beta premium of 3.34%.[85] In its Preliminary Decisions for NSW electricity distribution businesses, the AER described SFG Consulting's estimate of the zero-beta premium as "more plausible" than estimates put forward by other advisers.[86] Based on our experience in Australia, it is possible to compile, through application of a careful methodology, cost of equity estimates using the Black CAPM that are at least as robust as those derived using the SLM-CAPM. Given the limited time available to prepare this report, we have not had the opportunity to derive estimates for New Zealand. However, we suggest the Commission should not dismiss the feasibility of deriving robust estimates without having tried.

The Commission also notes in its Update Paper that the AER rejected the use of the Black CAPM as its fundamental model, and chose instead to use the Black CAPM as secondary evidence. This is factually correct. However, the Commission should note that the AER's decision to classify the SLM-CAPM as its "foundation model", and to treat all other estimation methods, financial models and other relevant information as secondary to the SLM-CAPM, is at the heart of a major merits review of the AER's decisions before the Australian Competition Tribunal, which will be completed before the Commission finalises its Input Methodologies review. Therefore, the Commission should not take comfort from the AER's decision to not use the Black CAPM as a direct estimation technique. The Commission should also not consider the AER approach as supporting the Commission's current approach of placing no reliance at all on evidence from the Black CAPM.

ERA

At approximately the same time the AER was developing its Rate of Return Guideline, the ERA in Western Australia was developing its own Rate of Return Guideline for the purposes of meeting the requirements under Australia's National Gas Rules. The ERA concluded that, at that time:[87]

> …only the Sharpe Lintner CAPM model is relevant for informing the Authority's estimation of the prevailing return on equity for the regulated firm

85 SFG Consulting (2014, Black).

86 See, for example, AER (2014), p.3-182.

87 ERA (2013), para. 113.

Subsequently, however, the ERA revisited this issue when considering its approach to estimating the rate of return for regulated rail networks. Having re-examined the evidence on this issue, the ERA concluded that the Black CAPM is a relevant model when determining the return on equity, and that it would use the Black CAPM to inform its SLM-CAPM estimates of the return on equity:[88]

> The Authority reviewed asset pricing approaches as part of its development of the gas Rate of Return Guidelines. The Authority's conclusion from that assessment was that only the Sharpe Lintner CAPM model is relevant for informing the Authority's estimation of the prevailing return on equity for the regulated firm, at the current time.
>
> However, the Authority in its recent GDS gas decision has accepted that the Dividend Growth Model (**DGM**) and the Black CAPM are relevant models for the purposes of determining the return on equity. In particular, the Authority utilised the estimates of the market return on equity and implied market risk premium (**MRP**) from the DGM to inform its forward looking MRP for use in the CAPM. In addition, the Black CAPM is considered when the point estimate of equity beta from a range is selected. Those conclusions are adopted for this rail WACC Final Decision. The Authority therefore retains the Sharpe-Lintner CAPM model for estimating the return on equity for the rail WACC for this Final Decision, but also utilises the other two models to inform its decision in relation to the return on equity.

In other words, the ERA started from the same position the Commission currently takes in relation to the SLM-CAPM, reconsidered the evidence available, and subsequently decided that it could improve on its estimates of the SLM-CAPM by having regard to the Black CAPM.

IPART

In December 2012, IPART commenced a major review of its methodology for estimating the cost of capital of regulated networks. During that review, IPART noted the empirical evidence suggests that the SLM-CAPM has a tendency to underestimate returns for low-beta stocks, and that the Black CAPM (which it referred to as the 'zero-beta CAPM') could be used to address this bias when implementing the SLM-CAPM:[89]

> Empirical evidence suggests that the security market line in the standard CAPM is too flat. That is, the expected returns for stocks with beta less than 1 are underestimated and the expected returns for stocks with beta greater than 1 are overestimated. The zero-beta CAPM addresses this bias by introducing a 'zero-beta' portfolio in place of the risk-free asset, where the returns of the zero-beta portfolio are uncorrelated with the market returns, like the risk-free asset, but are higher than the return on the risk-free asset. Given the difficulty in estimating the zero-beta CAPM, a pragmatic approach is to have regard to the potential bias in the cost of equity estimates under the standard CAPM in selecting the value for equity beta. That is, we could consider selecting a point estimate for the cost of equity above (below) the midpoint cost of

88 ERA (2015), p.xiii.

89 IPART (2013), p.29.

equity estimated based on the standard CAPM for stocks with beta less (greater) than 1.

4.2.3 The Commission has adopted methodologies in other areas that are not used widely by other regulators

Finally, we observe that the Commission has adopted in the existing Cost of Capital IM approaches that few or no other regulators use. For instance:

- No other regulator that we are aware of in the world uses the pseudo-statistical approach that the Commission has adopted in the Cost of Capital IM to construct an overall cost of capital range. The approach adopted by the Commission involves:[90]
  - Estimating the individual cost of capital parameters and their associated standard errors;[91]
  - Combining each of the point estimates for the individual parameters using the relevant cost of capital equation to obtain an overall cost of capital estimate (the 'midpoint' of the cost of capital range);
  - Making assumptions about the degree of correlation between the individual cost of capital parameters;
  - Combining the estimated standard errors for the individual parameters and assumption about correlations between parameters to estimate an overall 'standard error' for the cost of capital.
  - Applying this estimated standard error to either side of the cost of capital estimate to derive a cost of capital range.

  Many other regulators derive a cost of capital range and then select a point estimate from that range. But no regulator that we are aware of in Australia, the UK, Europe, North America, the Middle East, Asia or the Caribbean formulates a cost of capital range using the process described above. Nor is there any evidence that other practitioners (e.g., firms or corporate finance advisers) use this sort of approach to derive a cost of capital range for commercial purposes.
- No regulator that we know of anywhere, apart from the Queensland Competition Authority (QCA), uses the Siegel approach (see section 2) to estimate the TAMRP. Moreover, it is not as though the QCA has arrived at the use of the Siegel approach independently of the Commission. The QCA

90 Commission (2010), section H11.

91 In practice, the Commission's estimates of the standard errors of at least some of the parameters involve major assumptions that are difficult to substantiate, as well as guess work. Hence, the Commission's process of estimating the standard errors of individual parameters cannot be described properly as a statistical exercise.

uses the Siegel approach because it has been advised on this issue by the same expert as the Commission. There is no evidence that there is widespread use of the Siegel approach by firms or corporate finance advisers when estimating the market risk premium and survey participants indicate overwhelmingly that they do not use the Siegel approach when estimating equity risk premiums.

The Commission uses these approaches even when (virtually) no other regulator does so because it believes these approaches have merit. We think the Commission should approach models other than the SLM-CAPM in a similar way; that is, the Commission should assess those models on their merits and not invoke as an argument against those models an observation (incorrect as it is) that they are not used widely in practice.

4.3 How the Black CAPM may be used to derive better SLM CAPM estimates

As explained in section 4.2.2, those Australian regulators that have considered the Black CAPM in some depth have concluded that it may be used to derive better SLM CAPM estimates as follows:

1. Derive a range for equity beta estimates using the SLM-CAPM;
2. Recognise that the SLM-CAPM suffers from a low-beta bias; and
3. Use this insight as a justification for selecting a point estimate for the equity beta near or at the top of the estimated range.

Whilst we consider such an approach to be an improvement on the Commission's approach under the existing Cost of Capital IM, which leaves room for no models apart from the SLM-CAPM, we nevertheless think that this approach too is flawed. This is because there is no reason to suppose that the correction for low-beta bias must result in a beta estimate that lies within a range derived solely using the SLM-CAPM. Such a range reflects the precision with which the Commission considers it is able to estimate an unadjusted SLM-CAPM beta. There is no relationship between the precision of the SLM-CAPM beta and the extent to which it is biased. By analogy, suppose that we are able to determine that a faulty watch runs between 52 and 53 seconds per minute. This does not imply that the systematic bias can or ought to be corrected by taking the upper bound and concluding that a minute runs for 53 seconds.

A far more sound approach would be to quantify the extent of the bias, and then use that quantum to correct the SLM-CAPM cost of equity estimates. It is essential to recognise that the Commission would still be using the SLM-CAPM as its model for estimating the cost of equity. The only difference is that it would be using the Black CAPM to correct for a known bias in the SLM-CAPM. This would require only a minor change to the Commission's existing approach.

In its Rate of Return Guideline materials, the AER showed how the SLM-CAPM equity beta can be adjusted to account for the Black CAPM evidence of a low-beta bias.[92] Specifically, the AER shows how an estimate of the zero-beta premium can be used to derive an adjusted SLM-CAPM beta. The necessary steps are:

1. Estimate the SLM-CAPM equity beta;
2. Estimate the required return on equity under the Black CAPM, using the equity beta from step 1 above; and
3. Derive the equity beta that would have to be inserted into the SLM-CAPM to obtain an estimate of the required return on equity equal to that in step 2 above.

To see how this correction would work in practice, assume that:

- The risk-free rate is 2.95%, which is the Commission's most recent estimate;[93]
- The tax-adjusted TAMRP is 7.0%, which is the estimate that the Commission has used since it issued the existing Cost of Capital IM;[94]
- The unadjusted SLM-CAPM equity beta is 0.61, which is the estimate that the Commission has adopted most recently for Transpower;[95]
- The average investor tax rate is 28%, which is the Commission's existing estimate.

Under the Commission's current approach, the SLM-CAPM estimate of the cost of equity, using these parameter values, would be:

$$6.39\% = 2.95\% \times (1 - 28\%) + 0.61 \times 7.00\%.$$

As noted above, SFG Consulting has previously estimated the zero-beta premium (i.e., the extent of the downward bias in the SLM-CAPM) to be 3.34%.[96] For illustrative purposes, we adopt that estimate here. A cost of equity estimate that is fully corrected for the low-beta bias would be:[97]

$$7.33\% = (2.95\% + 3.34\%) \times (1 - 28\%) + 0.61 \times \big(7.00\% - 3.34\% \times (1 - 28\%)\big).$$

92 AER (2013 Appendices), Appendix C, Table C.11.

93 Commission (2015 Transpower), 22 December, p.7

94 Commission (2015 Transpower), 31 July, p.9.

95 Commission (2015 Transpower), 31 July, p.9.

96 SFG (2014 Black).

97 Note that this estimate makes allowance for the Simplified Brennan Lally adjustment for the partial imputation credit system in New Zealand.

Use of other models to improve the SLM-CAPM

The adjusted SLM-CAPM beta that corrects completely for the low-beta bias may be computed by solving for the beta estimate that equalises the SLM-CAPM and Black CAPM cost of equity estimates:

$$0.74 = \frac{7.33\% - 2.95\% \times (1 - 28\%)}{7.00\%}$$

The Commission need not put 100% weight on the correction for the low-beta bias; it could put some weight on the fully-corrected estimate and remaining weight on the uncorrected SLM-CAPM estimate.[98] The evidence of low-beta bias is very strong and the weights applied to the corrected and uncorrected beta estimates should be commensurate with the strength of that evidence.

If the Commission were to apply, say, 75% weight to the correction for low-beta bias and a 25% weight to the uncorrected starting-point SLM-CAPM estimate, it would be consistent with it being three times more likely that the Black CAPM evidence is real and systematic than a statistical artefact. If we were to apply such weights, the estimate of the equity beta adjusted for low-beta bias, in the example above, would be 0.71.

We recognise that the choice of weights requires the exercise of judgment, so we set out the adjusted beta estimates for a range of weights in Table 10.

The equity beta adjusted for low-beta bias also depends on the starting point SLM-CAPM beta that has been adopted. Figure 16 below shows how the adjusted equity beta varies according to the starting point beta and the weight applied to the low-beta correction.

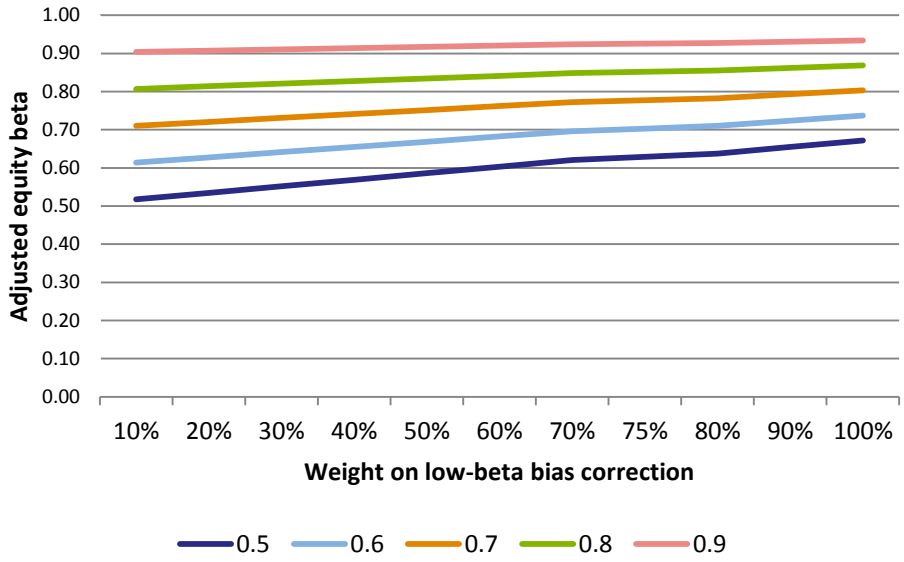
98 Regulators in the US have a long history of weighting SLM-CAPM and Black CAPM estimates. See, for instance: *Proceeding on Motion of the Commission to Consider Financial Regulatory Policies for New York State Utilities, CASE 91-M-0509, New York Public Service Commission 1994 N.Y. PUC LEXIS 141*; and *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Central Hudson Gas & Electric Corporation for Electric Service; Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Central Hudson Gas & Electric Corporation for Gas Service, 2006 N.Y. PUC LEXIS 227; 251 P.U.R.4th 20.*

Table 10: Sensitivity of adjusted equity beta estimates to the weight applied to low-beta bias correction

Weight applied to correction for low-beta bias	Adjusted equity beta estimate Starting beta of 0.5	Adjusted equity beta estimate Starting beta of 0.61	Adjusted equity beta estimate Starting beta of 0.7
0%	0.50	0.61	0.70
10%	0.52	0.62	0.71
20%	0.53	0.64	0.72
30%	0.55	0.65	0.73
40%	0.57	0.66	0.74
50%	0.59	0.68	0.75
60%	0.60	0.69	0.76
70%	0.62	0.70	0.77
75%	0.63	0.71	0.78
80%	0.64	0.72	0.78
90%	0.65	0.73	0.79
100%	0.67	0.74	0.80

Source: Frontier calculations

Figure 16: Sensitivity analysis for equity beta adjusted to correct low-beta bias



Source: Frontier calculations

We also note that the adjustment is relatively insensitive to a range of plausible estimates of the zero-beta premium. Table 11 below shows how the adjusted beta varies according to different estimates of the zero-beta premium. We consider a range of starting-point beta estimates and apply a 75% weight to the low-beta bias correction in each case.

Table 11: Sensitivity of adjusted beta estimate to estimate of the zero-beta premium

Zero-beta premium	Starting beta of 0.5	Starting beta of 0.61	Starting beta of 0.7
2.00%	0.58	0.67	0.75
2.50%	0.60	0.69	0.76
3.00%	0.62	0.70	0.77
3.34%	0.63	0.71	0.78
3.50%	0.64	0.72	0.78
4.00%	0.65	0.73	0.79

Source: Frontier calculations. Note: 75% weight applied to low-beta bias correction.

The table shows that the adjusted beta estimates are relatively insensitive to a wide range of estimates of the zero-beta premium. This should mitigate any reservations that the Commission may have about the feasibility of estimating the zero-beta premium with high precision. It also suggests that the magnitude of any plausible errors associated with imprecise estimates of the zero beta premium are likely to be far outweighed by the errors of relying exclusively on the SLM-CAPM, which is known to bias down cost of equity estimates for low beta stocks.

4.4 Conclusion

In this section we have shown that the Commission's suggestion that models other than the SLM-CAPM are rarely used by practitioners and regulators is incorrect:

- There is substantial evidence that corporate finance advisers make adjustments to their SLM-CAPM estimates, at least in part to compensate for weaknesses in the SLM-CAPM. The final effect of some of these adjustments is the application of a model that is something other than the SLM-CAPM.
- Regulators in North America commonly use the Black CAPM, in many instances alongside the SLM-CAPM.
- Those regulators in Australia that have given detailed consideration to the Black CAPM since the promulgation of the existing Cost of Capital IM in New Zealand have concluded that the Black CAPM can be used to improve their SLM-CAPM estimates of the cost of equity.

Furthermore:

- It is feasible to estimate the zero-beta premium. We have done so previously using Australian data, and there is no reason why a similar exercise could not be performed using New Zealand data. The AER has described our estimates of the zero-beta premium as "plausible".
- It is possible to use estimates of the zero-beta premium to derive improved SLM-CAPM estimates, i.e., estimates that correct for the low-beta bias of the SLM-CAPM that is now well-established empirically in the finance literature. We have shown that the betas corrected for this bias are relatively insensitive to the size of the zero-beta premium.

We recommend that the Commission continue to use the SLM-CAPM to estimate the cost of equity, but use estimates from the Black CAPM to improve its cost of equity estimates by correcting for the well-recognised low-beta bias associated with the SLM-CAPM. This would require only a minor change to the existing Cost of Capital IM.

Use of other models to improve the SLM-CAPM

5 Black's Simple Discount Rule

5.1 Overview

In its Update Paper, the Commission discusses the potential relevance of the so-called Black's Simple Discounting Rule (BSDR).[99] The Commission notes that the Major Energy Users' Group (MUEG) had engaged Ireland, Wallace and Associates (IWA) to consider how the BSDR might be used as some form of cross-check in the context of price control regulation,[100] and the Commission seeks further submissions on this point.

In our view, the BSDR has no useful role to play within the regulatory framework for the following reasons:

1. The rule could only produce risk-neutral cash flow estimates, which would serve no useful purpose in the regulatory process anyway;
2. The outcomes produced by implementing the rule would likely be volatile and unstable over time; and
3. The implementation of the rule would be complex and inevitably controversial.

We recommend that the BSDR play no part in the Cost of Capital IM.

5.2 The basis for the BSDR

When performing discounted cash flow (DCF) valuations, the standard approach is to set out the expected cash flows and to discount them back to present value using a risk-adjusted discount rate. Formally, the expected cash flows should be determined by taking a probability weighted average of the possible cash flows that might occur in each future period.

For example, consider a project that produces a single risky cash flow one year hence, where the distribution of possible cash flows is as set out in Table 12 below. In this case, the expected cash flow is 90×0.2 + 100×0.7 + 110×0.1 = 99. Further suppose that the risk-free rate is 5% and the premium for risk is 7%.[101] In this case, the standard DCF approach would value the project at:

$$V_0 = \frac{E[CF_1]}{(1+r)^n} = \frac{99}{1.12} = 88.$$

99 Commission (2015), pp. 31-34.

100 Commission (2015), p. 32.

101 This could be estimated using the Capital Asset Pricing Model (CAPM) or some other model(s).

Table 12: Sample cash flow probability distribution

Cash flow	Probability
90	20%
100	70%
110	10%

Source: Frontier

An alternative approach to valuation is to apply the risk adjustment to the cash flows, rather than to the discount rate. This is known as the **certainty equivalent** approach. The idea is to estimate a certainty equivalent cash flow such that investors would be indifferent between receiving that cash flow for sure or the risky cash flow above. For example, investors might be indifferent between receiving the risky cash flow above that has an expected amount of $99 or a guaranteed $93 with no risk at all.

If the cash flow adjustment for risk is computed in a way that is consistent with the discount rate adjustment for risk above, both approaches will produce the same present value:

$$V_0 \frac{E[CF_1] - Risk\ adjustment}{(1 + r_f)^n} = \frac{99 - 6}{1.05} = 88$$

In our view, none of this is controversial. The present value of an asset may be estimated by discounting expected cash flows using a risk-adjusted discount rate or by discounting certainty equivalent cash flows using the risk-free rate.

The former approach requires the use of an economic model such as the CAPM to estimate the risk-adjusted discount rate, and the latter approach requires a technique for determining the certainty equivalent cash flows.

5.3 Implementation of the BSDR

The IWA report for the MEUG cites some work by Loderer et al (2008, 2010) in relation to the implementation of the BSDR. IWA propose a four-step approach:[102]

1. Find a benchmark security with returns that closely correlates with the project's net cash flows;
2. Estimate the probability of negative excess benchmark returns (what risk-free percentile ensures the benchmark return);

[102] IWA (2015), p. 5.

3. Use management information to assess the NCFs that define the same percentiles in the cash flow distribution (the "conditional" expected cash flows that Black's Rule calls for); and

4. Discount the conditional cash flows at the matching risk-free rates to determine a valuation.

The first three of these steps are complex and require the application of judgment and assumptions. They would inevitably prove to be controversial in any regulatory setting.

The first step requires the identification of a traded stock or portfolio or index that has returns that are highly correlated with the net cash flows available to the shareholders of the supplier. This is a much more complex task than the identification of comparator firms for the purpose of estimating CAPM betas. When estimating betas, the task is to select comparator firms that (in the absence of leverage) are likely to have returns that share a common correlation with broad market returns. Firms in the same, or similar, industries are likely to have the desired characteristics. By contrast, the BSDR requires the identification of a stock or portfolio or index that has **returns** that are highly correlated with the regulated supplier's **net cash flows**. This is a complicated task that first requires the identification of different scenarios in which the supplier's **net cash flows** might be higher or lower than average, and then identifies listed stocks that have **returns** that would be high in the scenarios in which the regulated cash flows would be high and low when the regulated cash flows would be low. The usefulness and accuracy of the BSDR depends on the selection of an appropriate benchmark. IWA illustrate the approach using the US stock market index as the benchmark, but for adoption in the New Zealand regulatory setting there would need to be a full stakeholder engagement process on the selection of an appropriate benchmark or set of benchmarks.

The second step requires an estimate of the probability that the return of the stock or portfolio or index that is used as the benchmark might fall below the risk-free rate. This too is fraught with difficulty. IWA illustrates the approach using historical data – in what proportion of the historical one-year periods did the benchmark index return fall below the current risk-free rate? However, this would not seem to be a valid comparison as many of the historical observations were drawn from high-inflation years, whereas current inflation is low and stable. There would need to be a full stakeholder engagement process on the proper estimation of the probability that the benchmark security return (whatever that might be) would fall below the contemporaneous risk-free rate in the **prevailing** market conditions.

The third step is the most complex of all. What is required here is an estimate of the net cash flow to the supplier that occurs with the same probability of the benchmark security return falling below the contemporaneous risk-free rate. For example, suppose that we estimated that there was a 20% chance that, over the

coming year, the return of the benchmark security would be less than the contemporaneous one-year risk-free rate. We would then need to estimate, for the supplier, a figure such that there is a 20% chance that the net cash flow would be below that figure and an 80% chance that it would be above that figure. This would have to be done for every year separately. Clearly, this is a very complex task. The IWA suggestion of assuming some probability of a "pessimistic" scenario and assuming the cash flows that would eventuate in that scenario and assuming that cash flows follow a normal distribution and then applying interpolation involves the compounding of estimation error many times over. Every sub-step of this approach would need to be the subject of a stakeholder engagement process – the definition of a "pessimistic" scenario would have to be determined, the probability of such a scenario eventuating would have to be determined, the cash flows to the supplier in that scenario would have to be estimated, the shape of the probability distribution of possible net cash flows would have to be determined, and the appropriate interpolation approach (if any) would have to be determined.

5.4 Output from the BSDR

The output of the BDSR would be a set of certainty equivalent cash flows for the supplier – the set of cash flows that investors would require if those cash flows were certain and completely free of any risk. However, the regulatory approach requires a set of **real world** cash flows – the cash flows that investors actually require, given the level of risk that is involved.

In its report for MEUG, IWA (2015) recognises that:[103]

> While the NCFs are not strictly comparable, based on the stated set of assumptions the MAR derived NCFs materially exceed Black's Rule certainty equivalent NCFs over the term of the regulatory period. A detailed reconciliation of the two approaches has not been undertaken.

It is not clear what IWA mean by "not strictly" comparable – they are not at all comparable. One includes compensation for risk and the other does not. The only use of the certainty equivalent cash flows (even assuming that they have been estimated reliably) is as a lower bound for the real world cash flows. That is, the allowed cash flows (which must include appropriate compensation for risk) must be higher than the certainty equivalent cash flows (which do not include compensation for risk).

In fact, all that IWA have done is to show that the cash flows are lower if the compensation for risk is removed – that part of the allowed cash flow relates to compensation for risk. But of course, this was already well known. Consequently,

[103] IWA (2015), p. 7.

our view is that the BSDR serves no useful purpose and should play no part in the regulatory process.

What this means is that if the Commission's estimate of the cost of capital were below that implied by the BSDR the Commission could conclude that its estimate was too low, but if the Commission's estimate were above that implied by the BSDR, the BSDR would have nothing useful to say about whether the Commission's estimate was appropriate.

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