# Recommendations on priorities for review of cost of capital input methodology

A REPORT PREPARED FOR TRANSPOWER NEW ZEALAND

August 2015

# Recommendations on priorities for review of cost of capital input methodology



Contents

# Recommendations on priorities for review of cost of capital input methodology

## Figures

# Executive summary

Frontier Economics (Frontier) has been asked by Transpower New Zealand (Transpower) to consider the material the Commission has published for the Input Methodologies (IMs) review, and to provide recommendations on the priorities for the review of the cost of capital IM.

Whilst there are many potential areas in which the existing cost of capital IM could be fine-tuned and improved, in our view the Commission should concentrate its efforts on making incremental changes that would produce material improvements to the existing cost of capital IM. With that in mind, we have restricted our recommendations to those areas of the existing IM where:

- Major problems can be identified (i.e., where those elements are delivering poor outcomes for suppliers and/or consumers);
- There has been a material change in circumstances since the existing IMs were determined; and/or
- There have been new developments in regulatory thinking (e.g., to implement lessons learned following the global financial crisis, GFC), including in other jurisdictions with similar regulatory frameworks to New Zealand's.

## Overarching problem with the existing cost of capital IM

The existing cost of capital IM was developed over a period when the full effects of the GFC had not yet been felt. At that time, no-one, including the Commission, could have anticipated that government bond yields would drop to the historic lows experienced recently, or the fact corporate borrowing costs would peak at the levels experienced at the height of the GFC. The existing cost of capital IM may have been acceptable in the relatively stable pre-GFC world. However, the events of the GFC, and the years since, have exposed a major weakness in the current approach: namely, that cost of capital estimates derived using the existing IM can be very volatile, and produce unreliable WACC estimates.

For instance, the Commission's cost of capital estimates have declined sharply since 2010, in line with the material reduction in government bond yields. There is no mechanism within the existing cost of capital IM that recognises risk premiums faced by investors over the same period probably increased. Additionally, as the cost of debt estimates under the existing cost of capital IM tracks closely to the prevailing borrowing rates, the overall cost of debt allowance provided to suppliers will shoot up when debt markets are in crisis, and drop significantly when these crises dissipate. By contrast, the actual debt service costs faced by suppliers tend to be much more stable, because prudent businesses with

large debt portfolios (such as regulated networks) tend to stagger their refinancing, rather than reissue all their debt at once.

Volatility of this kind in the cost of capital allowance is bad for consumers (as changes in the Commission's cost of capital estimates eventually flow through to prices), and is bad for suppliers planning over long investment horizons.

The overarching problem with the existing cost of capital IM, identified above, is not unique to New Zealand. Since the events of the GFC, regulators around the world have re-examined their methodologies for estimating the cost of capital. In a number of cases, regulators have refined their approaches in ways that will lead to more stable and reasonable regulatory outcomes over time.

The recommendations in our report draw on the lessons learned overseas, and offer suggestions on ways in which the existing cost of capital IM may be improved incrementally, in order to produce more reliable estimates of suppliers' cost of capital.

## Recommendations

We have identified four areas where we consider the cost of capital IM could be improved significantly. Each is intended to improve the reliability of the estimates of WACC:

- **Cost of debt.** We recommended the use of a trailing average approach to estimating the cost of debt.
- **Market risk premium.** The Commission should implement a more transparent approach to assessing the evidence available to estimate the MRP than is set out in the cost of capital IM.
- **Cost of equity models.** We recommend the Commission move away from exclusive reliance on the (Simplified Brennan Lally version of the) Sharpe-Lintner-Mossin Capital Asset Pricing Model (SLM CAPM). Instead, the Commission should implement the Fama-French model, and the Black CAPM, as approaches to estimating the cost of equity, **in addition to** the SLM CAPM.
- **Beta estimation.** The Commission uses a single measure of risk, an estimate of the beta in the SLM CAPM, when deriving its estimates of the cost of equity. Estimates of this measure of risk are typically very 'noisy' and are likely to systematically understate the true risk. We recommend the Commission supplement its estimates of beta using estimates derived from a range of estimation techniques.

We discuss below each of these recommendations in further detail, and also comment briefly on how the Commission should deal with cost of capital issues raised recently by the High Court.

### Cost of debt

The Commission's current approach to estimating the cost of debt implicitly assumes that a supplier will refinance its entire debt portfolio just prior to the start of each regulatory period.

One problem with this is that suppliers would need to replicate this strategy in order to match their actual cost of capital to the allowed return the Commission determines.[1] Such a strategy would expose suppliers to massive refinancing risk.

In order to manage this refinancing risk, efficient and prudent businesses (regulated and unregulated) with large debt portfolios tend to issue debt of longer tenor than the Commission presently assumes, and stagger their refinancing. If efficient and prudent suppliers were to follow such a strategy, there would be a mismatch between their actual debt service costs and the cost of debt allowed by the Commission.

In principle, suppliers may mitigate some of this mismatch through hedging instruments (such as swaps). In practice, however, the instruments required to eliminate the mismatch do not exist in New Zealand. Hence, it is not feasible for even the most efficient and prudent suppliers to match their actual debt service costs to the allowances provided by the Commission.

The trailing average approach mimics the strategy of staggered refinancing, so would match more closely the debt service costs of efficient and prudent suppliers that manage their borrowing in such a way as to minimise refinancing risk. In addition, the approach is unbiased in the sense that the trailing average cost of debt is, by construction, no higher or lower than the expected cost of debt estimated over any particular short term period.

Finally, the trailing average approach would deliver much more stable allowed returns to suppliers and prices to consumers than does the approach in the existing cost of capital IM. Greater stability in allowed returns over time would help address the concern raised by electricity distribution businesses (EDBs) about the potential for divergences in the cost of capital estimates applied to suppliers regulated under the Default Price-Quality Path (DPP) and Customised Price-Quality Path (CPP) frameworks.

### Market risk premium

The existing cost of capital IM provides no transparent, objective framework for reaching a conclusion on the market risk premium (MRP) based upon different methodologies for estimating the MRP.

---

1 Any mismatch between the regulatory allowance and the actual cost of capital faced by the business will ultimately flow through to equity investors. In the extreme, large mismatches are, over the long-run, not financially sustainable.

We recommend the Commission implement a more explicit and structured approach to assessing the evidence available to estimate the MRP. Specifically, we recommend the Commission make a transparent assessment of evidence on the MRP based on historic excess returns and evidence on current, forward-looking estimates of the MRP. Finance theory suggests the Commission should only ever rely upon current equity prices and projections for earnings and dividends to estimate the expected market return. But reference to the MRP we would expect, on average (based upon past returns), mitigates against estimation error in timely estimates of the MRP. It reduces the chance that allowed returns swing too far from one period to the next based simply upon noise in the timely signals of the cost of equity.

### *Cost of equity models*

We recommended that the Commission implement the Fama-French model, and the Black CAPM, as approaches to estimating the cost of equity, in addition to the SLM CAPM.

There is no credible empirical evidence in any developed market that using the SLM CAPM, populated with beta estimates from regressing stock returns on market returns, leads to expected return estimates that line up with realised returns. The two models proposed above address specific systematic empirical weaknesses of the SLM CAPM:

- The Black CAPM addresses the result that the realised returns on stocks with low beta estimates are higher than the expected returns from the SLM CAPM. In the existing cost of capital IM, the Commission acknowledged the potential for the cost of equity to be under-estimated for stocks with relatively low beta estimates. Combining estimates from the Black CAPM and SLB CAPM would account directly for the possibility that the SBL CAPM underestimates the expected return on low beta stocks without making any ad hoc adjustments for model error.

- The Fama-French model addresses the result that the realised returns on stocks with high book-to-market ratios are systematically higher than the expected returns from the SLM CAPM.

The result of combining estimates from these three models would represent a more reliable estimate of the cost of equity than an estimate from any one of these models alone.

### *Beta estimation*

The Commission's task is to make its best estimate of the equity risk premium. One approach to this task is to estimate beta via regression of stock returns on market returns, and then multiply the beta estimate by an estimate of the MRP. This approach need not be the only way in which the equity risk premium can be

measured. If this method is retained as the sole approach to estimating the equity risk premium, the cost of equity will likely be understated because of the SLM CAPM's tendency to under-estimate risk for low beta stocks.

The existing analysis of the equity risk premium can be supplemented with:

- Beta estimates compiled with reference to revisions to analyst forecasts, rather than relying exclusively on stock returns;
- Equity risk premium estimates compiled using analyst forecasts of earnings and dividends, and adopting the dividend discount model;
- Consideration of the relative earnings yields and dividend yields of other stable companies with comparable beta estimates; and consideration of the beta estimates of other stable companies with comparable earnings yields and dividend yields; and
- Consideration of risk factors outside of the SBL CAPM, of which the most informative risk factor is likely to be the HML factor.

### *Issues raised by the High Court*

As the Commission noted in its June 2015 problem definition paper, the High Court raised a number of issues that the Commission has not yet addressed:

- The leverage anomaly associated with the SBL CAPM;
- The term credit spread differential (TCSD); and
- The split cost of capital approach.

We agree that the Commission needs to resolve these issues as part of the IM review, given the High Court direction. However, these issues should not be given undue prominence. The first two issues above can be considered as part of other, broader topics identified earlier in this report. The third topic (on the split cost of capital approach) should be examined and dismissed quickly.

The review of these three matters – each of which the Major Electricity Users' Group (MEUG) appealed with the purpose of reducing the WACC estimates produced by the cost of capital IMs – reinforces the need to ensure a balanced approach to the cost of capital IM that also addresses aspects of the IM which could result in unreliable or downward biased WACC estimates, as outlined in this report.

# 1 Introduction

## 1.1 Background

Frontier Economics (Frontier) has been asked by Transpower New Zealand (Transpower) to consider the material the Commission has published in relation to the forthcoming Input Methodologies (IMs) review, and to provide recommendations on the priorities for the review of the cost of capital IM.[2]

The views expressed in this report belong to Frontier, and do not necessarily represent the views of Transpower.

## 1.2 Objective of this report

The Commission's problem definition paper sets out the Commission's current view on the process it needs to follow through the IMs review. The Commission has identified four key steps:

1. Identify topic.
2. Define problems as they relate to Part 4 regulation and the IMs.
3. Identify and assess potential solutions.
4. Choose solutions that best promote the long-term benefit of consumers.

The focus of this report is on the first two steps: (1) the identification of topics of priority for the review of the cost of capital IM; and (2) articulating the specific problems that mean that these topics should be priorities for the forthcoming review.

In relation to some problems identified, we present proposed solutions based on our experience with recent regulatory developments in other jurisdictions. However, we recognise that detailed work on those areas will need to be undertaken during the course of the review proper, once the priorities for the review have been agreed.

## 1.3 Topics identified by the Commission

In the problem definition paper, the Commission identified nine topics it considers are important for the IMs review. Only some of these topics relate to the cost of capital.

---

2 The materials we have reviewed are the open letter open letter on the Commission's proposed scope, timing and focus for the review of input methodologies (published on 27 February 2015); and the problem definition paper (published on 16 June 2015).

In our view, the list of topics proposed by the Commission is incomplete and misses a number of issues that should be priorities for the review of the cost of capital IM. In this report we set out the topics that we consider are most important for the review of the cost of capital IM review, particularly for electricity networks.

## 1.4 Structure of the remainder of this report

The remainder of this report is organised as follows:

- Section 2 discusses the need to ensure that the forthcoming IM review, and subsequent amendments to the IMs going forward, promote rather than undermine regulatory certainty for suppliers and consumers.

The five sections that follow deal with key topics we recommend should be the focus of the review of the cost of capital IM:

- Section 3 deals with the question of whether certain elements of the cost of capital allowance should be indexed.
- Section 4 discusses the need for the cost of capital IM to take better account of the relationship between certain parameters – principally, the relationship between the risk-free rate and the market risk premium (MRP).
- Section 5 explains the need for the cost of capital IM to move away from exclusive reliance on the simplified Brennan-Lally Capital Asset Pricing Model (SBL CAPM), when estimating the cost of equity, and towards greater consideration of evidence from a wider set of models for estimating the cost of equity.
- Section 6 discusses the issue of beta estimation.
- Section 7 concludes by touching briefly on three issues raised by the High Court in its December 2013 judgment (the leverage anomaly associated with the SBL CAPM, the use of a split cost of capital approach, and the need for a term spread differential) that are yet to be resolved. We consider that these topics should be addressed as part of the cost of capital IM review, but should not be given undue prominence.

# 2 Promoting regulatory certainty

Section 52R of the Act makes clear that:

> The purpose of input methodologies is to promote certainty for suppliers and consumers in relation to the rules, requirements, and processes applying to the regulation, or proposed regulation, of goods or services under this Part.

Section 52A of the Act states that the purpose of Part 4 is the following:

> (1) The purpose of this Part is to promote the long-term benefit of consumers in markets referred to in section 52 by promoting outcomes that are consistent with outcomes produced in competitive markets such that suppliers of regulated goods or services—
>
> (a) have incentives to innovate and to invest, including in replacement, upgraded, and new assets; and
>
> (b) have incentives to improve efficiency and provide services at a quality that reflects consumer demands; and
>
> (c) share with consumers the benefits of efficiency gains in the supply of the regulated goods or services, including through lower prices; and
>
> (d) are limited in their ability to extract excessive profits.

The IMs should promote regulatory certainty for suppliers such that they can innovate, invest and pursue efficiencies for the long-term benefit of consumers, with the expectation of being able to recover the cost of their prudent and efficient investment.

In our view, the Commission should not interpret the promotion of regulatory certainty to mean that it should apply a completely mechanistic approach to setting the allowed rate of return. Some judgment is appropriate in order to respond to changes in current market conditions. However, this does not mean the Commission should make arbitrary judgements that do not have a sound basis. We consider that the Commission should strive for consistency and transparency and clearly explain its reasons for applying judgment.

Frequent changes to IMs that have large impacts on value are likely to undermine, rather than promote, regulatory certainty. The cost of capital is an element of the regulatory framework that has a significant effect on value, and drives investment activity. Hence, the Commission should, as a general rule, resist re-opening the cost of capital IM frequently.

Even in the context of major reviews of the IMs, such as the present one, the Commission should not attempt to reopen and examine every element of its cost of capital IM. Rather, it should prioritise those areas of the existing IM where:

- Major problems can be identified (i.e., where those elements are delivering poor outcomes for suppliers and/or consumers);

- There has been a material change in circumstances since the existing IMs were determined; or
- There have been new developments in regulatory thinking (e.g., to implement lessons learned following the global financial crisis), including in other jurisdictions with similar regulatory frameworks to New Zealand's.

The nature of the changes to the cost of capital IM we propose the Commission consider are aimed at enabling more efficient and prudent debt management by suppliers, and more accurate estimation of the cost of equity.

The implications of the global financial crisis (GFC) for the Commission's approach to estimation of the cost of capital were not understood completely at the time the existing cost of capital IM was developed. A number of years have passed now, and the events of the GFC have exposed significant weaknesses in the way regulators around the world (including the Commission) have traditionally approached cost of capital estimation. This has caused many regulators overseas to re-examine and make improvements to their own methodologies for estimating the cost of capital for regulated industries. The current IMs review is an opportunity for the Commission to consider the latest regulatory thinking that has emerged since 2010, and reflect those lessons in a revised cost of capital IM.

# 3 Indexation of the cost of debt allowance

## 3.1 The Commission's approach under the current IM

Under the current cost of capital IM, the cost of debt allowance is determined as follows:

$$Cost\ of\ debt = Risk\ free\ rate + Debt\ premium + Debt\ issuance\ costs.$$

When determining both the risk-free rate and the debt premium, the Commission applies a very short averaging period of historical rates; one calendar month.[3] This approach has been described (e.g., in Australia) as the 'rate-on-the-day' approach because the resulting cost of debt allowance will tend to be very close to the rate on any given day within the short (i.e., one calendar month) averaging period.

When determining the debt premium, the Commission references a small sample of domestic bonds. When determining debt issuance costs, the Commission references domestic issuances.

## 3.2 Weaknesses with the current approach

There are a number of major problems with the current approach, which are discussed in turn below.

### *The averaging period adopted*

A supplier that tries to align its actual cost of debt to the allowance provided by the Commission under the approach described above would need to refinance its entire debt portfolio within a very short window (i.e., approximately 22 trading days) in order to match the regulatory allowance.

In doing so, it would expose itself to significant refinancing and liquidity risk. For example, we understand that the funding task for Transpower is approximately $3.1 billion. In order to match the determination, Transpower would require approximately $140 million of five-year tenor debt to be raised evenly over the approximately 22 trading days of the determination window month. This is likely to be very challenging in a small, relatively illiquid corporate bond market such as New Zealand's.

The riskiness of this strategy is apparent if one considers what would happen if, for reasons beyond suppliers' control, bond markets were closed, or very illiquid, at the time all this refinancing needs to occur. This is not a purely academic consideration. Credit markets did in fact close during recent banking crises. If

[3] Commission (2015, Transpower Input Methodologies Determination), Subpart 5, 3.5.3 and 3.5.4, 5.

suppliers must refinance all their debt at once, but cannot do so due to market closures, one of two outcomes would occur. The supplier would need massive equity injections in order to keep operating (which, in the case of large network businesses is not feasible) and/or the supplier would be forced to default (which could be a very disruptive outcome for consumers).

The challenges associated with implementing the strategy implicit in the Commission's existing approach are likely to be exacerbated, particularly in New Zealand's relatively small debt capital market, by other suppliers seeking to raise finance around the same time, and may result in the suppliers paying a premium to refinance within that narrow window. Since the Commission presently determines the cost of debt allowance by sampling bonds issued by suppliers in New Zealand, this would ultimately increase the inputs to the cost of debt allowance determination and result in higher costs to electricity consumers.

In addition, since the refinancing window is reasonably easy to predict in advance (since the averaging period to be used is specified in the IMs), suppliers also face the risk that lenders might anticipate their need to refinance a large quantity of debt quickly, within a specific period of time, and may attempt to exploit this by price gouging. Once again, any increases in the suppliers' actual debt servicing costs as a result of such behaviour by bond market participants would ultimately flow through to the inputs to the cost of debt allowance determination and would result in higher costs to the electricity consumer.

### *The risk-free rate*

A supplier may be able to mitigate some of the refinancing risk associated with the base rate component of the cost of debt using interest rate swaps (assuming that the swap market in New Zealand is sufficiently deep to permit this).[4] However, in practice there are no similar instruments available to hedge the risk-free rate, which is determined from the five-year government bond rate. In practise the market hedges interest rate risk using interest rates swaps which have rates determined off the Bank Bill Mid-rate (BKBM). Lately, there has been a spread of approximately 50 basis points between these two rates, and the spread is volatile, varying between 30 basis points under to 65 basis points over the past five years. During some periods, the spread has widened by more than 100 basis points. This makes effective hedging of the risk-free rate component challenging.[5]

Hedging closer to the five year government bond rate, using alternate strategies with non-vanilla interest rate swaps is expensive due to the bespoke nature of the hedging solutions, which is worn by the supplier and not compensated through

4 Implementing such hedging strategies also incurs some transaction costs.

5 Data derived from Bloomberg.

## Indexation of the cost of debt allowance

the regulatory framework. We are advised by Tranpsower that the time delay between the determination window and the start of the regulatory control period (RCP) requires the use of forward starting interest rate swaps to enable suppliers to effectively hedge interest rates against the rate set during the determination window for the period of the RCP. This forward starting cost is on average c.a. 20 – 25 bps and is not compensated through the Commission's WACC determination. In addition, there is considerable market risk associated with executing a hedging strategy against the government bond due to the relatively illiquid market in comparison to the swap market.

### *The debt premium*

There are no instruments, such as Credit Default Swaps (CDS), available to suppliers in New Zealand, which can be used to hedge the refinancing risk associated with the debt premium component of the cost of debt. Hence, under the current IM approach, there is no implementable debt management strategy that can replicate the cost of debt allowance. Thus, there will always be some mismatch between the regulatory allowance and the actual debt service cost. This mismatch (which could be negative or positive and would change over time) would flow through to equity holders as an additional risk to bear.

Prudent corporate issuers of a large debt portfolio diversify the portfolio to mitigate refinancing risks. Diversification involves:

- Varied financing dates;
- Varied maturities and tenors;
- Varied debt capital markets access; and
- Varied alternative funding sources such as committed standby arrangements, active short term and long term programmes.

Evidence from overseas suggests that efficient and prudent infrastructure businesses (regulated and unregulated) tend to borrow for a 10-year term and stagger their debt refinancing (e.g., by rolling over 10% of their portfolio) each year. Under such a debt management approach, the actual cost of debt of these businesses will be a 10-year average of historical yields. We understand that Transpower has followed such a strategy.

Access to foreign debt capital market sources involves costs not currently allowed by the Commission, such as higher credit margins than local debt capital markets and cross currency basis costs associated with swapping foreign denominated debt into local currencies. Prudent issuers incur these costs associated with diversifying refinancing risks.

The sample of corporate bonds used in the determination of the debt premium is narrow and illiquid. Some of the issues are as low as $25 million issued debt.

These are tightly held and do not trade frequently. The use of the narrow sample size increases the risk of determining the debt premium incorrectly.

Section 52A of the Act states that the purpose of Part 4 is:

> (1) … to promote the long-term benefit of consumers in markets referred to in section 52 by promoting outcomes that are consistent with outcomes produced in competitive markets… [Emphasis added]

To the extent that the Commission's current approach to setting the cost of debt allowance produces outcomes that cannot be matched by even unregulated infrastructure businesses, the Commission's approach would not be consistent with achieving the purpose of Part 4. Specifically, it would promote outcomes that are not consistent with outcomes produced in competitive markets, and would expose suppliers to additional and unnecessary risk for no benefit to consumers.

It is important to recognise that **all** of the problems described above arise directly as a result of the Commission's chosen approach to determining the cost of debt allowance. These problems have also arisen in overseas jurisdictions. In Australia and elsewhere, regulators have recognised that the solution to these problems is to change the regulatory approach by moving to a trailing average approach to setting the cost of debt allowance.

## 3.3 The trailing average approach to setting the cost of debt allowance

In its open letter, the Commission signalled that "indexation of the cost of debt" could be a major topic at the forthcoming IM review.[6] Then, in its problem definition paper the Commission mentions the indexation of the cost of debt (as a way of reducing the differences between the default price-quality path and customised price-quality path outcomes in relation to the cost of debt).[7]

As the Commission noted in its problem definition paper, a number of regulators overseas have adopted or proposed indexation of the cost of debt.

In addition to the examples cited by the Commission, we note that:

- the economic regulator in South Australia, ESCOSA, has recently proposed to adopt the trailing average approach as means of setting the return on debt allowance provided to SA Water;[8] and

6 Commission (2015, open letter), para. 31.3.

7 Commission (2015, problem definition paper), paras. 194-195.

8 ESCOSA (2015).

- the economic regulator in Victoria, the ESC, is currently considering the use application of the trailing average approach when setting the return on debt allowance provided to regulated water businesses.[9]

Under the trailing average approach, the cost of debt allowance (excluding debt issuance costs) at the start of the regulatory period is set by taking a historical average of the spot yields to maturity on debt. This allowance is then updated annually through the regulatory period. In Australia and in Great Britain, the trailing average approach is based on:

- Corporate debt (with a given credit rating) with a 10-year term to maturity;
- A 10-year historical averaging period; and
- Historical yields published by an independent third party (e.g., Bloomberg and the Reserve Bank of Australia).

The trailing average approach offers a number of significant benefits that would overcome the problems identified in section 3.2. Specifically, the trailing average approach:

- Produces a cost of debt allowance that is commensurate with the efficient and prudent financing practices of infrastructure businesses, including suppliers.
- Results in a cost of debt allowance that is achievable by a supplier that implements an efficient and prudent debt management strategy. This would in turn result in less mismatch between suppliers' actual cost of debt and the allowed cost of debt. This, in turn should reduce cash flow volatility over time.
- Results in a much smoother profile of allowed returns and, therefore, less volatile regulated prices over time. This would promote certainty for suppliers and consumers, in line with the objectives of the IMs. In addition, reduced volatility in allowed returns over time would help address the potential for large mismatches between the Commission's estimates of the cost of capital for Electricity Distribution Businesses (EDBs) regulated under the Default Price-Quality Path (DPP) framework and the Customised Price-Quality Path (CPP) framework — a concern that some EDBs have raised.

The AER provided the following rationale for adopting the trailing average approach:[10]

---

9 ESC (2015).

10 AER (2013), p.12.

> This approach means that the allowed return on debt more closely aligns with the efficient debt financing practices of regulated businesses and means that prices are likely to be less volatile over time. The trailing average would be calculated over a ten year period. The annual updating of the trailing average should also reduce the potential for a mismatch between the allowed return on debt and the return on debt for a benchmark efficient entity. This should reduce cash flow volatility over the longer term.

In Australia, the adoption of the trailing average approach by the AER was in fact proposed by large energy users because these customers considered that the approach would result in more stable cost of debt allowances (and, therefore, prices) not driven by volatility in debt markets.[11]

ESCOSA's rationale for proposing the trailing average approach is similar. ESCOSA stated the following in relation to its recent proposal to adopt the trailing average approach: [12]

> The proposed approach involves setting a ten-year trailing average cost of debt, updated annually during the regulatory period to reflect prevailing rates. This recognises the historic costs of debt incurred over a ten year period, while also encouraging efficient new investment through the annual update, consistent with the "new entrant" approach.
>
> It explicitly recognises that it is prudent and efficient for a large water and sewerage business, such as SA Water, to enter into long-term debt financing arrangements given the long-term supply obligations and long asset lives that the business must invest in.
>
> The approach is expected to reduce risk and therefore costs to consumers in the long-term, bearing in mind the nature and scale of the regulatory obligations and the regulated entity.
>
> The proposed approach is also increasingly becoming standard regulatory practice within Australia for application in industries such as energy and water, where the regulated businesses generally have significant debt requirements, long-term supply obligations and long asset lives. It has been adopted or endorsed by other jurisdictional and national regulatory and policy bodies over the past three years.
>
> It is also consistent with observed financing practices of large infrastructure businesses and with the requirements of the National Water Initiative (Principle 1 of the NWI Principles for the recovery of capital expenditure) and the overarching statutory framework under the Water Industry Act 2012.
>
> Under this approach, SA Water is incentivised to finance any new investments at or below the prevailing efficient market rates, meaning that consumers ultimately pay only the efficient cost of those investments. For legacy investments, the approach recognises only efficient past financing practices (not rewarding inefficient practices), encourages efficient management of the re-financing costs of those investments over time. In that way it reduces the volatility inherent in a shorter-term approach, which

11 AEMC, p.59.

12 ESCOSA (2015), pp. 3-4.

## Indexation of the cost of debt allowance

assumes all legacy financing costs will be re-financed at the start of each new regulatory period.

Importantly, the proposed approach is based on an assessment of the actions of a benchmark prudent and efficient utility with the same obligations as SA Water. It does not look to the actual actions, costs or legal structure of SA Water itself.

The approach proposed will:

- protect consumers from any possible costs of poor financing decisions made by SA Water by providing a benchmark rate of return
- provide SA Water with a reasonable opportunity to earn sufficient revenue to attract equity and debt needed to finance regulated services, and
- incentivise SA Water to outperform the benchmark rate of return.

## 3.4 The Commission's past consideration of indexation

The Commission notes in its problem definition paper (para. 195) that it briefly considered indexation when setting the original IMs, but rejected the indexing approach at that time on the basis that it would violate the NPV=0 principle.[13]

The Commission should reconsider the trailing average proposal as part of the review of the cost of capital IM, on the grounds that:

- The Commission's consideration of indexing when developing its 2009 Revised Draft Guidelines was very brief.
- Those considerations related to a very different problem to that identified in this report (see section 3.2). When developing the original IMs, the Commission considered indexation as a way of addressing the concern that, because interest rates have a tendency to be volatile over time and mean-revert, if regulated rates happen to be set at a point that is close to either a peak or trough of the interest rate cycle, rates could move significantly during a regulatory period. This, in turn, could mean that suppliers are 'locked in' to a rate that is significantly too high or too low relative to the actual funding

13 The Commission seems to be driven to its existing approach in order to adhere strictly to the NPV=0 principle. We do not necessarily disagree with the NPV=0 principle. But we do not think that it should be an overriding principle that rules out all other considerations. Rather, the Commission should view the NPV=0 principle as one among a number of relevant considerations when determining the cost of capital allowance. Moreover, over the long life of a regulated asset, the average allowance for the cost of debt will be the same whether it is based on the rate-on-the-day approach or the trailing average approach. Thus, both approaches can be consistent with an NPV=0 outcome over the life of the asset. Finally, we note that the general principle of matching the regulatory allowance to the efficient cost (which is the basis for the trailing average approach) is entirely consistent with the NPV=0 principle.

costs of an efficient supplier. Whilst volatility in the cost of capital is a valid consideration, we have identified a number of other problems in relation to the present method of setting the cost of debt allowance. Specifically, the current approach:

- Is inconsistent with the debt management strategy of efficient and prudent infrastructure businesses;
- Exposes suppliers to significant refinancing risk; and
- Results in a regulatory allowance that cannot be matched in practice by even the most efficient and prudent suppliers using available hedging instruments.

- Regulatory thinking and practice on this issue has advanced considerably in other jurisdictions. Some regulators overseas have implemented the trailing average approach, and articulated clearly the reasons for its adoption. As a matter of good regulatory policy, the Commission should consider, as part of the present review, whether lessons from those jurisdictions are applicable in the New Zealand context.

## 3.5 Relevant considerations for the IM review

When considering the trailing average approach, as part of the IM review, the Commission should have regard to the following issues:

- The economic rationale for the trailing average approach, and the benefits to suppliers and consumers of adopting the approach (i.e., the extent to which it addresses the problems identified in section 3.2).
- Implementation questions, for example:
  - Data sources;
  - The specifics of the calculation of the trailing average (e.g., the term assumption, the weighting scheme to be employed, the credit rating assumption to be applied); and
  - The mechanics of the updating of allowed revenues through the regulatory period.

All of these issues have been considered and addressed in some detail by regulators overseas. Hence, the Commission should draw on that valuable experience when evaluating this issue.

# 4 Market risk premium

## 4.1 Estimating the market risk premium in the existing cost of capital IM

As noted above in Section 3.1, under the existing cost of capital IM, the risk-free rate (for both the cost of debt and the cost of equity allowance) is determined by applying a one calendar month average of historical yields on New Zealand government bonds. The term of the risk-free rate is aligned with the length of the regulatory period, which, under the DPP framework and Transpower's Individual Price-Quality Path (IPP) framework, is five years.[14]

In the cost of capital IM the Commission reported a risk-free rate of 4.64% based upon the five-year government bond yields observed during August 2010.[15] Using data for the month of June 2010, the risk-free rate would be estimated at 3.22%.

In Figure 1 below we illustrate the monthly average annualised yield to maturity on five-year government bonds from March 1985 to June 2015. The figure shows the substantial reduction in government bond yields during the 1980s as inflation declined.[16] It then shows further reductions in government bond yields following the GFC that began in the second half of 2008.

In the cost of capital IM the Commission states that its best estimate of the tax-adjusted market risk premium (TAMRP) in normal market conditions is 7.0%.[17] The Commission allowed for a temporary uplift to the market-risk premium (MRP) to 7.5% for a period coinciding with the global financial crisis, which for practical purposes was considered to last for the 2010 and 2011 calendar years.[18] Hence, for a business regulated over the period 1 January 2011 to 31 December 2015 the TAMRP premium would be 7.1%.[19]

---

14 Commission (2010), para. H4.1, p. 434.

15 Commission (2010), para. 6.7.7, Table 6.4, p. 167. Our computation of the average annualised yield to maturity on five year government bonds during August 2010 is 4.56%, using government bond yields reported by the Reserve Bank of New Zealand. We convert reported yields to effective annual rates using the formula, effective annual rate = (1 + nominal yield ÷ 2)$^2$ – 1. We are unsure why the Commission reports a higher figure.

16 The average annual inflation rate for New Zealand, estimated on a quarterly basis, from 1985 to 1990 was 10.3%. From 1991 until the March quarter of 2015, the average annual inflation rate, estimated on a quarterly basis, has been 2.3%. For the most recent 3.5 year period, ending in March 2015, the average inflation rate has been 1.1%.

17 Commission (2010), para. H7.1, p. 477.

18 Commission (2010), para. H7.2, p. 477.

19 7.5% × 1 ÷ 5 + 7.0% × 4 ÷ 5 = 0.015 + 0.056 = 7.1%.

Figure 1: Five-year government bond yields from March 1985 to June 2015


*Source: Reserve Bank of New Zealand and Frontier Economics*

This means that, at 1 September 2010, when the cost of capital IM was released, the Commission's estimate of the risk-free rate was 4.64% and its estimate of the MRP was 7.1%. This also means that, in combination with an investor tax rate of 28.2%,[20] the Commission's estimate of the expected return for a typical stock in the market (that is, a stock with a beta of one) would be 10.43%.[21]

It is also possible to summarise what the position would be if the Commission were to continue to apply its existing methodology and maintain its 7.0% estimate of the TAMRP. The risk-free rate would be 3.22%, the TAMRP would be 7.0%, and the investor tax rate would be 28.0%.[22] This means that the Commission's estimate of the expected return for a stock of 'average' risk in the market would fall to 9.32%.[23]

In short, the Commission's estimate of the expected equity return for the typical stock would fall by 1.12% if the Commission were to maintain its 7.0% estimate

20 The investor tax rate is discussed subsequently.

21 Cost of equity = Risk-free rate × (1 – investor tax rate) + Equity beta × Tax adjusted MRP = 0.0464 × (1 – 0.282) + 1 × 0.071 = 0.0333 + 0.071 = 10.43%.

22 As mentioned above, the investor tax rate is discussed subsequently.

23 Cost of equity = Risk-free rate × (1 – investor tax rate) + Equity beta × Tax adjusted MRP = 0.0322 × (1 – 0.280) + 1 × 0.070 = 0.0232 + 0.070 = 9.32%.

of the TAMRP and if it were to maintain its methodology for estimating the risk-free rate and investor tax rate. As we discuss in more detail below, this outcome is not consistent with signals from the equity market about the cost of capital. Over the month of August 2010, the trailing 12-month earnings yield (earnings per share divided by price per share) for the NZ50 stocks was 4.5%.[24] For the month of June 2015, the earnings yield has increased by 0.5% to 5.0%. Dividend yields have moved in the same direction. Over the month of August 2010, the trailing 12-month dividend yield for the NZ50 stocks was 3.8%. For the month of June 2015, the dividend yield increased by 0.7% to 4.5%. These increases in earnings and dividend yields are consistent with an increase in equity risk premiums – investors are discounting earnings (or dividends) back to present value at a higher rate, producing lower prices for a given level of earnings (or dividends).

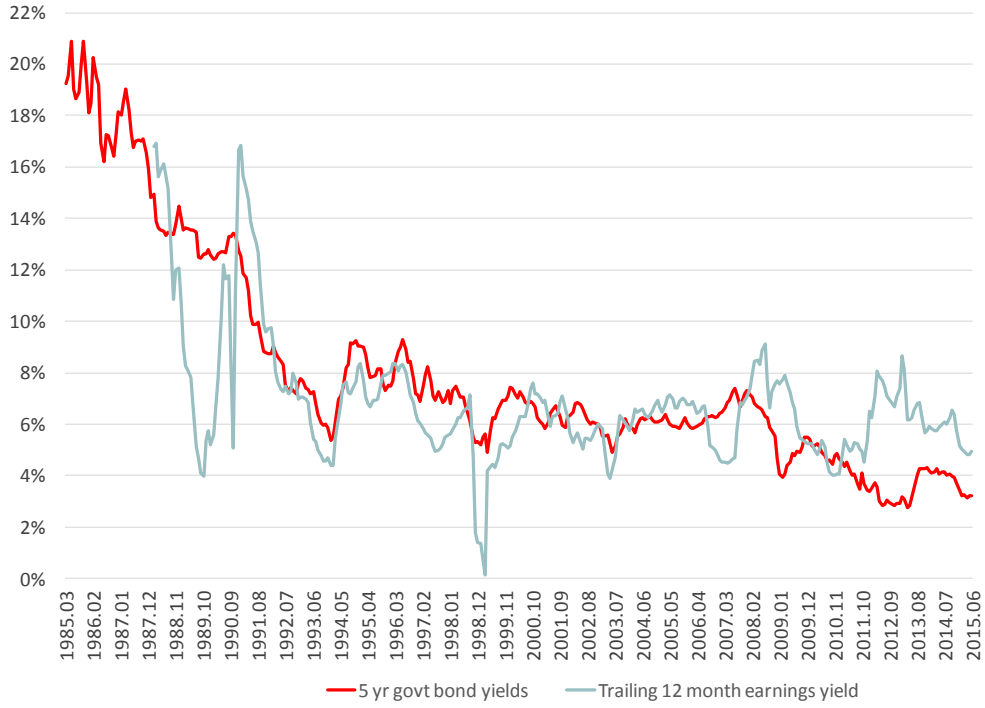
Figure 2 overlays the 12 month trailing earnings yield on the five-year government bond yield from the previous figure. The figure shows that, in general, the earnings yield and the government bond yield move in the same direction. There are some periods of relatively short-lived volatile movements in the earnings yield, but most of the time these are reversed quickly. However, in years subsequent to the GFC of 2008 there has generally been a persistent gap between the earnings yield and the government bond yield. From July 2008 to June 2015, the median difference between the earnings yield and the yield on five-year government bonds has been 1.8%. This can be compared to a median difference of –0.7% from January 1988 to June 2008. The same median difference of –0.7% is evident from January 1992 to June 2008, a period coinciding with materially lower government bond yields than observed previously.

The recent premium of the earnings yield over five-year government bond yields is not just a feature of the New Zealand markets. The same phenomenon has been observed in Australia. Subsequent to the GFC a persistent premium of the earnings yield over the five year government bond yield has been observed, as is illustrated in Figure 3.

From July 2008 to June 2015, the median difference between the earnings yield and the yield on five-year government bonds has been 1.9%. In contrast the median difference in yields was −2.6% from January 1984 to June 2015 and −1.9% from January 1992 to June 2015.

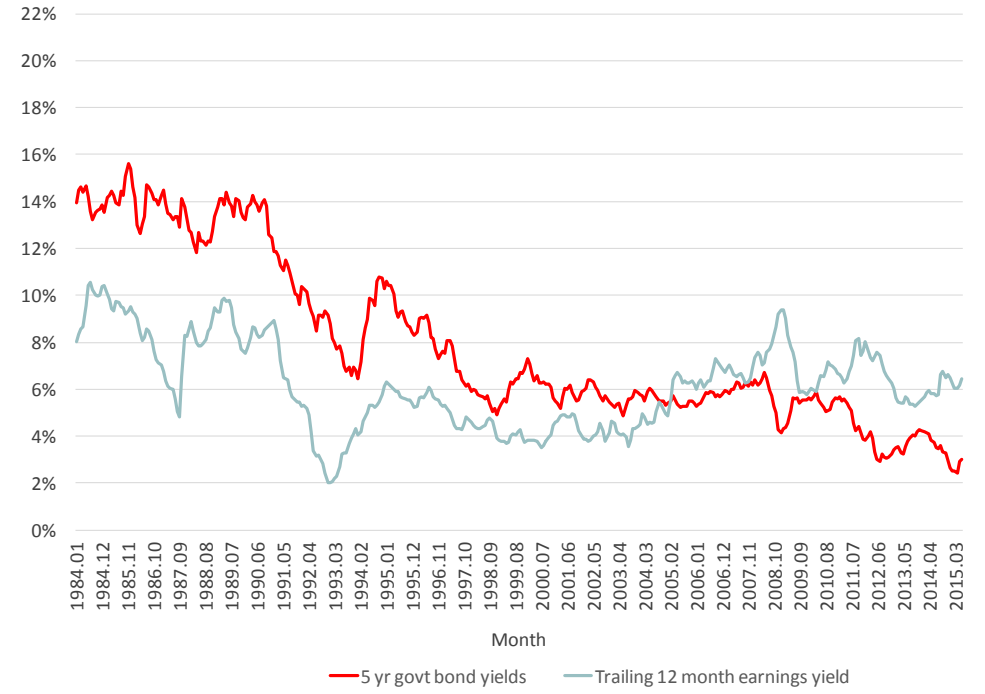
24 The earnings yield is the inverse of the price-earnings ratio. So an average earnings yield of 4.5% corresponds to a price-earnings ratio of 22.2.

Figure 2: Government bond yields and 12 month trailing earnings yields in New Zealand




*Source: Reserve Bank of New Zealand and Frontier Economics*

Figure 3: Government bond yields and 12 month trailing earnings yields in Australia



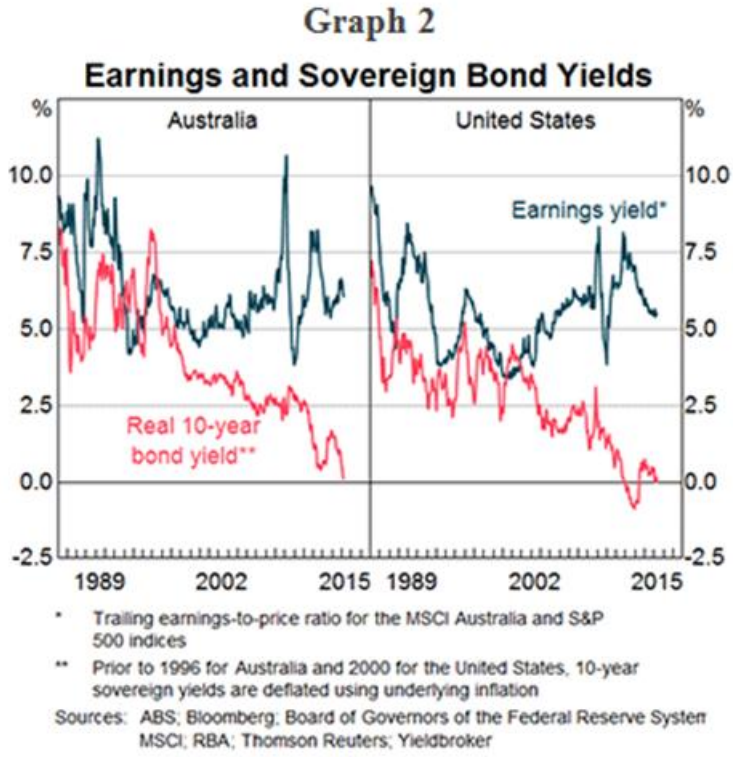

*Source: Reserve Bank of Australia and Frontier Economics*

## Market risk premium

The proposition that the MRP has widened with recent falls in government bond yields was also recently given credence by Governor of the Reserve Bank of Australia, Glenn Stevens. In a speech in New York on 21 April 2015, Governor Stevens stated that the equity risk premium appears to have risen to offset the recent falls in the risk-free rate such that the required return on equity has not fallen:

> …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.[25] [Emphasis added]

Figure 4: Government bond yields and earnings yields in Australia and the United States




*Source: Reserve Bank of Australia*

Governor Stevens went on to note that the returns on equity required by investors have not shifted even though risk-free rates have fallen to exceptionally low levels:

[25] Glenn Stevens, Speech to the Australian American Association, New York, 21 April 2015.

> …it might be explained simply by stickiness in the sorts of 'hurdle rates' that decision makers expect investments to clear. I cannot speak about US corporates, but this would seem to be consistent with the observation that we tend to hear from Australian liaison contacts that **the hurdle rates of return that boards of directors apply to investment propositions have not shifted, despite the exceptionally low returns available on low-risk assets**.[26]

He went on further to explain that:

> …the risk premium being required by those who make decisions about real capital investment has risen by the same amount that the riskless rates affected by central banks have fallen.[27]

The analysis presented in this section calls into question the appropriateness of the Commission's approach of adopting a MRP estimate of 7.0%, which is based primarily on historic excess returns. We have a signal from the equity market that the cost of equity has not fallen in line with the risk-free rate. Yet as discussed below, there is really no mechanism for this equity market signal to be reflected in the Commission's estimate of the MRP.

We agree with the Commission that analysis of historical excess returns provides useful information for estimating the MRP. However, this issue has only come to a head in the last seven years because of persistently low government bond yields — an outcome that was not foreseen at the time the existing cost of capital IM was developed. The evidence from the equity market is that the required return on stocks has not fallen as far as the required return on government debt. There is no substantial impediment to the Commission making an estimate of the MRP that addresses this limitation.

## 4.2 Weaknesses with the current approach to estimating the market risk premium

### 4.2.1 Timely market information has little impact

The Commission's assessment of the MRP is informed by analysis of past returns, a dividend discount model analysis based upon stock prices and dividends, and survey results. The Commission's approach almost guarantees that the expected market return will move in the same direction as government bond yields, and therefore does not provide a timely (i.e., current, forward-looking) estimate of the MRP.

We make some recommendations as to how these limitations can be overcome. In the current report, we do not implement specific estimates of the MRP.

---

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

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

However, we have previously made current, forward-looking estimates of the MRP in Australia, using a range of different estimation techniques – including for the economic regulator in New South Wales, IPART.[28] All of the estimation techniques we have applied to Australia can be applied to making an estimate of the MRP in New Zealand.

The Commission did not reach a **definitive conclusion** on what the MRP could be if it relied entirely on historical returns, what the MRP would be if it relied entirely on timely signals of market returns, and what are the relative merits of these two estimation approaches. It is reasonable to say that the Commission considers a range of estimates of the MRP. But there remains ambiguity over what the Commission's view is on the relative merits of these estimates. We consider that this ambiguity impedes the Commission's ability to make an estimate of the MRP that is an appropriate trade-off between the signals from past returns data and signals from the equity market at a point in time.

Referring to Table H12 of the cost of capital IM, we observe that the Commission makes the following estimates of the TAMRP:[29]

- The Ibbotson method (which is estimating the historical average difference between market returns and government bond yields, also known as excess returns) provides an estimate of 7.27% for the New Zealand market, 7.67% for the US market and 7.50% from other markets. So the assessment of the Commission is that, if exclusive reliance were given to historical excess returns, the MRP lies somewhere from 7.27% to 7.67%.

- The Siegel method (under which historical excess returns are adjusted for what is considered to have been unexpected inflation) provides an estimate of 6.40% for the New Zealand market, 7.30% for the US market and 6.60% for other markets. So the assessment of the Commission is that, if exclusive reliance were given to historical excess returns, and an adjustment were made for what is considered to be unexpected inflation, the MRP lies somewhere from 6.40% to 7.30%.

- This means that we have two estimates of the MRP that are based entirely upon long-run historical excess returns. Depending upon how much confidence the Commission places in the adjustment for unexpected inflation, and how much the Commission relies upon the relevance of New Zealand evidence, versus the merits of looking at more (but less relevant) data from other countries, the MRP could lie anywhere from **6.40% to 7.67%**.

---

28 IPART (2013).

29 Commission (2010), Table H12, p. 494.

- The Cornell method (which is a derivation of the MRP estimate under the dividend discount model, assuming constant growth in dividends in perpetuity) provides an estimate of the tax adjusted MRP of 5.20% for New Zealand-listed stocks, and 6.80% for US-listed stocks.
- This means that the timely signal from the equity market, according to the Commission's estimates in 2010, was that the MRP was somewhere from **5.20% to 6.80%**, again depending upon the relative merits the Commission ascribes to the New Zealand versus US markets.
- The Commission reports estimates of survey results which have the tax adjusted MRP at 8.20% for New Zealand and 6.90% for the US. It is unclear whether survey respondents are making an estimate of the MRP on the basis of historical returns, or timely signals from the equity market. Survey-based estimates are simply the opinions of survey respondents as to what would be a good number to use. All we can infer from the survey-based estimates is that respondents to the surveys considered by the Commission thought that a useful estimate of the tax adjusted MRP lies somewhere from **6.90% to 8.20%**.

The Commission reviewed these MRP estimates and made its own assessment of 7.0%, which is also informed by consideration of other regulators' decisions and the MRP estimates used by other practitioners. The limitation of the Commission's approach is that, in circumstances like the present case, there really is no mechanism to change the MRP estimate in response to signals from the equity market.

Consider the analysis of historical excess returns. The adjustment for unexpected inflation results in a materially lower estimate of the MRP. We do not think that this adjustment has any merit. The basis of the adjustment for unexpected inflation is that this one particular shock to the equity and bond markets can be stripped out, and that we know that market returns had an upward bias because of this shock. We do not know that this is true. There are a vast number of shocks that hit the equity and bond markets in the last century, and it is not possible to say that the impact of inflation was the one substantial shock that can be isolated (or given primacy) in order the make the "correct" inference from historical excess returns.

However, what we do not have is a clear indication of the Commission's view on the merits of the adjustment to historical excess returns. All we know from the cost of capital IM is that the best estimate of historical excess returns is somewhere from **7.27% to 7.67%** without an inflation adjustment, and **6.40% to 7.30%** with an inflation adjustment.

Forming a view on the merits of this inflation adjustment is important. We are not saying that the Commission needs to necessarily select one of these given ranges – the Commission could form a view as to the relative merits of these two

sets of historical return estimates. But we consider the Commission should form (and state) a conclusion as to what the MRP would be, if only historical excess returns were considered.

We also consider that the Commission should reach (and state) some conclusion on the relative merits of analysis of stocks listed in New Zealand, the US, and other markets.

This issue is important because, in the absence of conclusions about historical excess returns, there appears to be no prospect that timely information about the cost of equity can be incorporated into the MRP estimate. Suppose that a timely estimate of the MRP, based upon current share prices, was 8.00% and all other MRP estimates were unchanged. This is not inconceivable, as it would mean a nominal market return of 10.32%, and a real market return of around 7.11% to 8.16% at inflation rates of 2% to 3%.[30] What would the Commission's final estimate of the TAMRP be? Would this be sufficient to shift the TAMRP above 7.0%? Or asked another way, what timely estimate of the MRP would be sufficient to shift the TAMRP above 7.0%?

The Commission should also reach (and state) a clear conclusion as to what survey estimates mean for estimating the MRP. As mentioned above, a survey estimate represents a respondent's view as to an appropriate MRP, and so the survey outcome depends upon how much weight respondents place on historical excess returns in forming an opinion. At present, what we have is the Commission's summary of survey estimates of the MRP, but no view from the Commission as to what the survey outcomes mean.

The Commission is already forming opinions on the relative merits of each piece of evidence. These opinions are internalised and non-transparent. The entire range of MRP estimates considered above is 5.20% to 8.20%, and the Commission's 7.00% estimate sits within this range. So it cannot be said that the MRP estimate is entirely inconsistent with the evidence. But neither is a MRP estimate of 6.00% or 8.00%.

The only realistic way that timely information could be reflected is to answer the following questions:

- On the basis of past returns information alone, what would be the Commission's estimate of the MRP? This could be informed by analysis of historical excess returns as well as historical real returns, which are then converted to nominal returns at current inflation expectations. This is discussed in a subsequent section. This conclusion could be informed by

30 Assuming a risk-free rate of 3.22% and tax-adjusted MRP of 8.00% the nominal market return is $0.0322 \times (1 - 0.2800) + 0.0800 = 0.0232 + 0.0800 = 10.32\%$. At an inflation rate of 2% the implied real market return = $1.1032 \div 1.0200 - 1 = 8.16\%$; and at an inflation rate of 3% the implied real market return = $1.1032 \div 1.0300 - 1 = 7.11\%$.

relative consideration of returns with and without an inflation adjustment, and with relative consideration of returns from New Zealand, the US and other markets.

- On the basis of survey responses alone, what would be the Commission's estimate of the MRP? This conclusion could be informed by the relative merits of different surveys, as well as the relevance of different equity markets.
- On the basis of timely information about the expected market return alone, what would be the Commission's estimate of the MRP? This conclusion could be informed by dividend discount model analysis of the MRP, as well as other market indicators, such as implied volatility and corporate bond spreads.
- On the basis of the three MRP estimates considered above (i.e., based upon past returns, survey responses and current market information), what would be Commission's estimate of the MRP?

Only if these questions are answered will we have a reasonable indication of how timely market information is likely to lead to changes in the Commission's estimate of the MRP. It is important to emphasise that this does not impose any more burden on the Commission than it already faces. The Commission is already making an internal assessment of these issues in order to reach the conclusion that the tax adjusted MRP is 7%.

### 4.2.2 Movements in government bond yields carry disproportionate weight

In section 4.2.1 we pointed out that under the current cost of capital IM, timely information about the market cost of equity has little chance of making a material impact on the Commission's MRP estimate. This occurs because the Commission places high reliance on past excess returns and survey evidence, in conjunction with the absence of definitive statements as to what past returns implies for the MRP, what share prices today imply for the MRP, and how a conclusion is reached from these two signals.

This ultimately means that movements in government bond yields from one period to the next will be the primary determinant of the expected market return from one period to the next. Yields on government bonds in New Zealand, and other developed markets, are at unprecedented lows because there remains high demand amongst investors for a default risk free investments, but less willingness amongst governments to borrow additional funds to finance deficits.

This issue came to prominence amongst regulators and regulated businesses during the GFC, during which there was no doubt that investors sold equities and bought government bonds during a flight to quality. This was recognised by

the Commission in its estimate of a 7.5% TAMRP for the crisis period. However, understanding the relationship between government bond yields and the MRP has been overshadowed by too much emphasis on the crisis, and arguments over *the* relationship between government bond yields and the MRP.

With respect to *the* relationship between government bond yields and the MRP, this issue cannot be resolved in isolation because there is no single relationship between government bond yields and the MRP:

- There are some circumstances in which government bond yields decline and the cost of equity rises (e.g., a flight to quality);
- There are some circumstances in which government bond yields decline and the cost of equity falls (e.g., investors cannot earn sufficient returns to meet their obligations by buying risk free investments so bid up the price of risky investments; or there is a reduction in inflation expectations); and
- There are some circumstances in which government bond yields decline and the cost of equity stays the same (e.g., investors buy government bonds and equities for different reasons and are prepared to pay a premium for the default free investment but this does not increase demand for a risky investment).

The three possible outcomes for the cost of equity, associated with a decline in government bond yields, map to three different ways of estimating the MRP:

- By considering current stock prices, earnings forecasts, dividend forecasts and the dividend discount model, we can estimate directly the cost of equity in a manner independent of the government bond yield, so we can account for the situation in which the cost of equity rises.
- By considering historical excess returns we have an estimate of the equity risk premium that is constant at any government bond yield, so we account for the situation in which the cost of equity falls.
- By considering historical real returns, we have an estimate of the real equity market return that is constant regardless of the government bond yield, so we account for the situation in which the real cost of equity stays the same.

It is important to use all three approaches to estimating the MRP because it is almost never clear which situation characterises market conditions at a given point in time. The Commission's current approach to estimating the MRP assumes implicitly that the second situation holds almost all the time, and so a fall in government bond yields implies a fall in the cost of equity. In the GFC the Commission gave some small consideration to the possibility that the MRP has widened, as shown by an increase in the TAMRP of 0.5%. It appears, the Commission has had no regard to the possibility that the best estimate of the real cost of equity could be equal to the historical average real equity return.

Consideration of whether to analyse historic excess returns, or historic real returns, has only come to light in recent years due to the sustained falls in government bond yields. At government bond yields of 6% it makes little difference whether an historic average premium is added to estimate the market return. But at government bond yields of 3% the differences in outcomes are stark. Hence, it is only in recent years (i.e., after the development of the current cost of capital IM) that this issue has come to the fore. Hence, the Commission should give serious consideration to this issue during the current IM review.

Our view is straightforward:

- If exclusive (or almost complete) reliance in estimating the MRP is based upon historic excess returns, the implication is that the expected market return has continued to fall over seven years. This view cannot be sustained because it ignores completely the relationship between share prices and earnings that can be observed in the equity market. It also means that almost all movement in allowed returns to equity investors will be determined by changes in the price that investors in a risk free asset are prepared to pay. There is no reason to think that pricing of government debt and equity investments is so closely aligned.
- If exclusive (or almost complete) reliance in estimating the MRP is based upon historic real returns, the implication is that the MRP today is very wide and that the market return per unit of risk is very wide because equity market volatility is not particularly high. This view also cannot be sustained. While it is not reasonable to contend that government bond yields and required equity returns move exactly in synch, it is also unreasonable to contend that prices of government bonds and equities are determined entirely independently of one another.
- If exclusive (or almost complete) reliance in estimating the MRP is based upon current share prices, earnings forecasts, dividend forecasts and the dividend discount model, there is considerable estimation error without the error mitigation of examining historic excess returns and historic real returns.
- This means that estimating the MRP can be done by:

  (1) estimating the MRP from historical returns – considering both historic excess returns and historic real returns;

  (2) estimating the MRP from analysis of prices, earnings forecasts, dividend forecasts and the dividend discount model; and

  (3) giving consideration to both estimates of the MRP on the basis of an assessment of their relevance and reliability.

## 4.3 Current approaches of Australian regulators

Australian regulators and appeal bodies have adopted timely indicators of MRP estimates to different degrees in different jurisdictions. The differing approaches are discussed below.

The approach taken by the QCA most closely approximates that of the Commission. Like the Commission, the QCA considers historic excess returns (5.8% to 6.6%), historic excess returns adjusted for inflation (4.1% to 6.6%), survey evidence (6.8%) and an estimate of the MRP from the dividend discount model (5.6% to 8.3%).[31] At present the QCA's estimate of the MRP is 6.5%, which reflects its judgement as to how these four estimation approaches should be reconciled. Our recommendation to the QCA would be the same as we recommend to the Commission – to make an explicit statement as to what MRP is implied by historic returns (excess returns and real market returns), make an explicit statement as to what MRP is implied by timely information on market returns, and reach a conclusion from these two MRP estimates on the basis of their relevance and reliability.

In Western Australia, the Economic Regulation Authority (ERA) has adopted a conceptual approach that is close to what we would recommend to the Commission for giving consideration to different sources of evidence. The ERA (2015)[32] considered both historic excess returns and historic real returns in making an estimate of the MRP based upon past returns. The MRP range from this evidence was 5.5% to 8.9%. This can be contrasted with the ERA's range of estimates from the MRP implied by current share prices, earnings forecasts and dividend forecasts, which was 5.6% to 9.7%. On the basis of the MRP estimates from past returns (5.5% to 8.9%) and current information (5.6% to 9.7%) the ERA ultimately made an estimate of the MRP of 7.6%.

We would not make the same estimates of the MRP from current information as the ERA. But the issue at present is about reconciliation of different information to reach a conclusion. We would also recommend that both ranges listed above can still be used to reach a conclusion on the best estimate of the MRP from the two sources of evidence. There is a general reluctance on the part of regulators, as evidenced in their decisions, to assign a best estimate of the MRP from each source of evidence. There is no harm in reaching this definitive conclusion. It does not mean the conclusion is made with any more or less precision, and the uncertainty over the estimate can still be conveyed by the regulator reporting a range of different estimates. Reaching conclusions simply means everyone in the regulator's process can understand the thought process that went into reaching the conclusion.

---

31 QCA (2014), Section 10.7.

32 ERA (2015), para. 1165 to 1260.

In New South Wales, IPART (2015) derives an estimate of the cost of capital on a long term average basis (and therefore uses a long term average excess returns estimate of the MRP), derives an estimate of the cost of capital using timely information, and averages these two cost of capital estimates. The timely estimate of the MRP takes into account several dividend discount model estimates of the expected market return, as well as an estimate of the MRP based upon market indicators (dividend yields, risk-free rate, term spread and corporate bond spread).

The AER (2015) states that it places most reliance on historic excess returns in estimating the MRP, places second most reliance on dividend discount model estimates of the expected market return, and only considers historic average real returns as an overall check on the cost of equity estimate for an energy network.[33, 34] We disagree with the AER's view on the relevance of historic real equity returns. In our view, much greater weighting should be given to estimates from the dividend discount model, which provides timely estimates of the MRP.

In the Australian Capital Territory, the Industry Panel (2015) placed all reliance on a timely estimate of the MRP. The MRP estimates adopted by the Industry Panel were those compiled by Bloomberg over a 40 day averaging period.[35]

This means that, amongst different regulators and appeal bodies, there is disagreement over the relative merits of examining historic excess returns, historic real returns and timely estimates of the MRP. Our view is that all three ways to estimate the MRP are relevant and reliance on all three approaches will mitigate estimation error. Further, there is nothing to be lost and much to be gained by reaching conclusions on what past data, and timely information, means for estimates of the MRP. Simply reporting these two intermediate estimates of the MRP, and then reaching a conclusion on the MRP, would increase significantly the transparency in the Commission's decision-making.

---

33 AER (2015), Table 3.13, pp. 88 to 90.

34 The AER has bundled the analysis of historic real returns to estimate the MRP into the so-called 'Wright approach' to estimating the cost of equity, on the basis that the Wright approach is a novel way to think about the cost of equity that differs from what the AER considers to be a standard way of applying the CAPM. The 'Wright approach' is a name that the AER has given to an argument that was advanced by Professor Stephen Wright of Birkbeck College, London, who submitted that there has historically been evidence of an inverse relationship between the risk-free rate and the MRP, whereas the real market return has been very stable. Wright argued that if this holds, going forward, regulators should adjust the MRP in the opposite direction to any movements in the risk-free rate, rather than simply hold the MRP constant. The Wright approach to estimating the cost of equity makes only one point – that consideration needs to be given to using historical real market returns as an estimate of real market returns in the future.

35 Industry Panel (2015), Box 5.1, p. 65.

# 5 Use of models other than the SBL CAPM to determine the cost of equity allowance

## 5.1 The basis for the CAPM as the sole cost of equity model

The Commission relies exclusively on the SBL CAPM to estimate the cost of equity. The basis for the Commission's reliance on this model is the Commission's view that the model has a sound theoretical basis, and the extensive use of the CAPM in corporate finance practice.

With respect to theory, there is no question that, if the assumptions that underpin the CAPM hold, then it is theoretically sound. But the real question is whether the actual violation of those assumptions in practice is sufficiently strong to negate its usefulness for estimating the cost of equity. Stocks are not traded in a frictionless market in which participants have equal access to information, and form the same views on expected returns and risk. And investors cannot borrow and lend unlimited amounts at a single risk-free rate. Nor does the economy exist for a single period. Hence, the view that the CAPM is reliable merely because it holds true under its assumptions is no basis for reliance.[36]

With respect to the CAPM, there is now an extensive body of evidence to suggest that it is not a sufficient approximation of reality to be relied upon as the sole model for estimating the cost of equity. The CAPM does not need to be (and should not be) replaced by another single model. Rather, the Commission should use a set of models to estimate the cost of equity, and reach a decision based upon the outcome from that set of models.

It is true that the CAPM is used widely by corporate finance practitioners (e.g., when valuing competing investment opportunities). However, these experts spend most of their efforts in assessing the range of cash flows that could be generated by alternative investments than estimating as precisely as possible the discount rate to be applied in valuing those cash flows. This is because, typically, corporate finance practitioners are interested in ranking competing investments by value so as to select the best investments to make. The ranking of projects is approximately the same, regardless of the discount rate assumed, especially if the competing investments are in similar industries. Hence, there is little need for

[36] The issue is the same faced by an engineer who needs to decide whether to rely upon equations based upon the assumption of a frictionless surface; or an options trader who needs to decide whether to rely upon equations based upon the assumption that stock returns are normally distributed. Neither of these assumptions is true, and so the corresponding equations are false. The only question is whether, despite the assumptions not being true, the equations are a sufficiently close approximation to reality to be relied upon, and how much consideration to be given to other information.

corporate finance practitioners to expend effort deriving the most precise estimate possible of the cost of capital of alternative projects (including by means of applying models other than the CAPM).

It is not the case that the CAPM has acceptance in corporate finance practice because it has been established by empirical evidence as the pre-eminent statement of the risk-return relationship. Its acceptance in corporate finance practice has more to do with the ease which it can be explained and applied than any overwhelming empirical evidence the CAPM is the pre-eminent statement of the risk-return relationship.[37] Moreover, the implementation of the CAPM in practice is quite unlike the strict and mechanistic implementation adopted by the Commission. It is common for practitioners to made various adjustments to correct for some of the known systematic biases of the CAPM.

The proliferation of asset pricing research has continued, because the academic finance community recognises that sole reliance should not be placed upon the CAPM as a model for understanding asset pricing or for estimating required returns.

When it comes to the role of the Commission, consideration of the asset pricing models to use is of paramount importance because it determines directly the revenues that a supplier will be permitted to earn, and the prices that consumers will pay. It is far more important for the Commission to derive the best possible estimate of the cost of capital than for corporate finance practitioners choosing amongst a suite of alternative projects. For regulated entities, the debate over whether the right cost of capital is 9%, 10%, or 11% is very important. For this reason, we consider that the Commission should be at the forefront of corporate finance practice.

This does not mean the Commission needs to react to every new publication or working paper that speculates on a new asset pricing model. It is appropriate for the Commission to make incremental changes to its approaches, on the basis of consideration of a body of evidence. Yet the fact remains that the model and parameter estimation approaches used by the Commission are the same as those that were evaluated four decades ago, and have never since been shown to generate reliable and complete estimates of the cost of capital.

We consider this empirical evidence below. On the basis of this empirical evidence, we propose that the Commission estimate the cost of equity using the CAPM, Black CAPM, and the Fama-French model, and reach a conclusion on the basis of estimates from all three models. The Black CAPM and the Fama-French model each address an important, and well-established empirical result,

37 The application of the standard CAPM requires estimation of just three parameters, and application of the SBL CAPM requires estimation of just four parameters.

## Use of models other than the SBL CAPM to determine the cost of equity allowance

and the parameters of each model can be estimated and have been estimated for regulatory purposes in other jurisdictions.

## 5.2 The SBL CAPM's ability to reflect the specifics of the New Zealand tax system

A key reason that the Commission gave in its original cost of capital IM for preferring the SBL CAPM is its ability to reflect the specifics of the imputation credit system in New Zealand. In this regard, it is important for the Commission to recognise that the SBL CAPM makes many simplifying assumptions (e.g., that imputation credits are utilised fully by all investors), which do not hold in practice. So, it is not the case that the SBL CAPM is a completely accurate and faithful representation of the circumstances of New Zealand's tax system.

The selection of the CAPM, the Black CAPM, the Fama-French model, or a combination of all three models, to estimate the cost of equity can be made regardless of whether New Zealand has an imputation system or not. It is not the case that the imputation system necessitates the use of the CAPM to estimate the cost of equity.

Under the CAPM, there is an estimate of the risk-free rate and the equity risk premium. These estimates are modified in the SBL CAPM to account for investors receiving the full benefit of imputation credits. The cost of equity from the Black CAPM and the Fama-French model can also be disaggregated into the same two components (risk-free rate and equity risk premium) in order to account for investors receiving the full benefit of imputation credits (or whatever portion of that is deemed to be appropriate).

Further, even if the CAPM was the only model that could be modified to account for the specifics of the imputation tax system (which is not true), it is unclear to us why the Commission places such emphasis on reflecting the specifics of New Zealand's tax system, and gives such little weight to the estimation errors that are likely to be introduced by utilising a single model to the exclusion of all others. What is so special about dividend imputation that it should be given primacy in the Commission's choice over evidence other asset pricing models, which the empirical evidence suggests perform better than the standard CAPM?

## 5.3 Empirical evidence and the implications for alternative asset pricing equations

In the cost of capital IM, the Commission acknowledged the potential for the cost of equity to be under-estimated for stocks with low beta estimates. Yet the Commission rejected the use of alternative models, namely the Black CAPM and

the Fama-French model. Both models were rejected on the basis of a lack of support amongst corporate finance practitioners. The Fama-French model was rejected on the basis of a lack of theoretical support, and alternative explanations for the empirical results. The Black CAPM was rejected because, in the prior submissions, there was no rebuttal to empirical evidence of Pettengill, Sundaram and Mathur (1995) in favour of the CAPM and no justification for the use of the Black CAPM other than it better fits the market data.

With respect to corporate finance practice, we discuss this issue in section 5.1. With respect to theoretical support for the Fama-French model, and explanations for the empirical results, we consider this in our discussion of the evidence below. On the Black CAPM, and the research by Pettengill, Sundaram and Mathur (1995), in section 6.2.3 we show that the research method necessarily leads to evidence that appears to support the CAPM, even in a situation in which the beta estimate has nothing to do with expected returns. Hence, the well-established result that beta estimates have little or no association with average returns still implies that the CAPM does not provide a reliable and complete estimate of the cost of equity. In terms of whether the Black CAPM ought to be used merely because it better fits the data, we discuss this issue in relation to the evidence on the Black CAPM.

There are two key empirical results to consider, that have direct implications for the suite of asset pricing models that the Commission could adopt:

- **Low beta bias.** The returns on stocks with low beta estimates are too low compared to what is predicted by the CAPM. The low beta bias can be addressed by using the Black CAPM, which requires an estimate of the zero beta premium. We have previously conducted this exercise using data for all Australian-listed stocks over a 20-year period and arrived at an estimate of 3.34%.[38] This analysis can be conducted for any equity market with a large number of listed companies, including New Zealand, the US and the UK. The Commission has relied upon data from these markets to estimate beta and the MRP, and there is no reason why the zero beta premium cannot be estimated for the same markets. This means that for all comparable firms identified by the Commission, and used to estimate the equity risk premium as the product of beta and the MRP, it is possible to estimate the cost of equity using the Black CAPM.

- **Returns performance of high book-to-market stocks.** The returns on stocks with high book-to-market ratios are higher than predicted by the CAPM. This can be addressed using the Fama-French model, which requires estimation of risk coefficients and risk premiums. We have previously

38 SFG Consulting (2014, Black).

## Use of models other than the SBL CAPM to determine the cost of equity allowance

conducted this exercise using data for stocks listed in Australia and the US.[39] It is feasible to extend the analysis to estimate the Fama-French factors for stocks listed in New Zealand and the UK. This means that, for all comparable firms identified by the Commission, it is possible to estimate the cost of equity using the Fama-French model.

## 5.4 The Black Capital Asset Pricing Model

### 5.4.1 Empirical support

The Black CAPM[40] was developed shortly after the CAPM of Sharpe, Lintner and Mossin. It was developed at a time during which there was extensive testing of the CAPM, and researchers were attempting to understand the relationship between beta estimates and stock returns. In particular, researchers were trying to understand why low beta stocks earned returns that were too high compared to those predicted by the CAPM, and high beta stocks earned returns that were too low compared to those predicted by the CAPM.

This result has never been overturned in any sound empirical study.[41] There is research that provides support for the theory of the CAPM. For instance, recent work by Da, Guo and Jagannathan (2012) provides evidence that if we strip out the component of returns that can be explained by the book-to-market ratio, company-specific volatility and return on investment, and we strip out the component of beta explained by the same three characteristics, we can find a positive association between the adjusted beta estimates and the adjusted returns. So if we explain some different returns with some different beta estimates, we could say they the CAPM is one useful way to think about risk and return. We agree – the CAPM is a useful way to think about risk and return. But we ought not to ignore the returns that are explained by the characteristics other than the beta estimate.

There is also the work by Levy and Roll (2010) who defend the use of the CAPM, and call into question the research that questions its usefulness. Levy and Roll make the point that realised stock returns are very noisy, and suggest that, statistically, it is possible to find the result that beta estimates do not line up well with realised returns even if the CAPM actually holds. Their point is that it may be the inability to estimate reliably and precisely the various input parameters that

39 SFG Consulting (2015).

40 Black (1972).

41 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).

are responsible for the poor performance of the Sharpe-Lintner-Mossin CAPM (SLM CAPM).

This is an interesting theoretical idea, but does nothing to change the fact that the empirical implementation of the CAPM provides a poor fit to the data. Levy and Roll (2010) can only conclude that the poor performance of the SLM CAPM **may** be due to the inability to reliably estimate the parameters. Unfortunately, their approach cannot help at all in actually improving the reliability of those parameter estimates. That is, their work provides a potential explanation, rather than a solution, for the poor performance of the model. The CAPM, as implemented by the Commission, provides a very poor fit to the observed data. Fama and French (2004) make the same point when they state that:

> this possibility cannot be used to justify the way the CAPM is currently applied. The problem is that applications typically use the same market proxies, like the value-weight portfolio of US stocks, that lead to rejections of the model in empirical tests. The contradictions of the CAPM observed when such proxies are used in tests of the model show up as bad estimates of expected returns in applications ... in short, if a market proxy does not work in tests of the CAPM, it does not work in applications.[42]

In their recent research, Savor and Wilson (2014) split their sample period into days of major economic announcements, versus non-announcement days. They find that on the 10% of days in which there is a major economic announcement, there is a positive association between beta estimates and stock returns. On non-announcement days there is a small inverse relationship between beta estimates and stock returns. The researchers' explanation for this result is that there could be a better signal to noise ratio on announcement days, so they have a powerful test. They acknowledge, however, that "a good theory should explain both what happens most of the time and where the majority of cumulative returns come from."[43] So, even if there is some evidence that supports the CAPM, it is not possible to find any relationship between beta estimates and stock returns for 90% of trading days.

However, there is a more benign and mechanical reason for the result. In section 6.2.3 we show that if a sample is split into periods of high and low market returns, we will necessarily find a relationship between beta estimates and returns in the direction predicted by the CAPM, even if in reality there is no association between beta and expected returns. This is exactly what occurs in the analysis of Savor and Wilson (2014). On announcement days, market returns are much higher than on non-announcement days, averaging about 0.7% on announcement days and about 0.1% on non-announcement days. The key point is that, even with a model in which the expected return for all stocks is equal to the market return, if a sample is split into periods of high versus low market returns, a

42 Fama and French (2004, pp. 43–44.

43 Savor and Wilson (2004), p. 196.

## Use of models other than the SBL CAPM to determine the cost of equity allowance

positive association between beta estimates and stock returns when market returns are high will be found; and a negative association between beta estimates and stock returns when market returns are low will be found.[44]

### 5.4.2 Theory and implementation

The Black CAPM was conceived when this empirical evidence was in its early stages. The idea is that there is another set of assumptions which lead to a slightly different asset pricing model, and which is more consistent with the empirical evidence. Under the Black CAPM, investors are no longer assumed to borrow and lend at a single risk-free rate of interest (as per the standard or SBL CAPM), in order to achieve their preferences for risk and return. Instead, we have the concept of the zero beta portfolio – a portfolio which has no systematic risk, with an expected return that lies above the risk-free rate and below the expected market return.

The Black CAPM is as theoretically sound as the CAPM. They are just models that are useful for understanding risk-return relationships, given a set of assumptions about the market. Yet the Black CAPM is the model that is more consistent with historical returns data than is the SLM CAPM. The Commission could either continue to adopt one theory (the SBL CAPM) on the basis that decades of historical returns might not be enough to know whether average returns approximate expectations; or it could use another theory (the Black CAPM) on the basis its predictions line up better with the returns data actually observed; or, and this is our recommendation, the Commission could use both models to generate an overall cost of equity estimate that is likely to be more reliable and complete than the estimate from any one model.

The Commission is correct when it says that, in practice, the CAPM is used. Practitioners estimate a risk-free rate with reference to government bond yields, rather than the expected return on a zero beta asset. In practice, most of the time the analyst is not faced with beta estimates that are particularly high or low compared to the beta of one for a typical firm. But when practitioners are faced with a situation in which the beta estimate is substantially different from one, analysts are likely to exercise a degree of caution and actually adopt a cost of equity estimate that is closer to the expected market return than predicted by a strict implementation of the CAPM.

We suggest that the cost of equity under the Black CAPM be estimated by making an explicit estimate of the zero beta premium. This would address the

44 The researchers do control for periods of large market movements, arguing that their result is not mechanical. But in this control they consider the absolute market movement (that is, whether the market had large positive or negative returns). The point we make in section 6.2.3, and which was previously made by Cooper (2009), is about the direction of market returns.

Commission's strong objection to making ad hoc adjustments to the allowed return.[45]

We have already conducted a similar analysis in relation to regulated networks in Australia.[46] We found that once the return to portfolios in different markets (positive and negative excess returns) are analysed, there is a weak positive association between beta estimates and stock returns.[47] But this was only present if we ensured that portfolios were not contaminated by differences in other stock characteristics, namely differences in market capitalisation, book-to-market ratio or industry.

What is most important, however, is that:

- there is a **weak** positive association between beta estimates and portfolio returns; and
- the analysis implies an estimate of the expected return on a zero beta asset that is **above the yield on government bonds**.

Our specific estimate of the zero beta premium was 3.34% per year.[48] As an example, this means that if the risk-free rate was 5.00%, the MRP was 7.00% and the beta estimate was 0.80, the cost of equity from the SLM CAPM would be 10.60%,[49] and the cost of equity from the Black CAPM would be 11.27%.[50]

The analysis can be performed with respect to the New Zealand, US and UK markets, all of which have been relied upon by the Commission to estimate beta and the MRP. If the Black CAPM is used in conjunction with the SBL CAPM, the result is likely to be a more reliable and complete estimate of the cost of equity. It will account directly for the possibility that the SBL CAPM underestimates the expected returns on low beta stocks without making any ad hoc adjustments for model error.

---

45 Commission (2010), para. 6.4.20 to 6.4.31, pp. 148 to 151.

46 SFG Consulting (2014 Black).

47 In particular, see SFG Consulting (2014 Black CAPM), Figure 10, p. 26.

48 SFG Consulting (2014 Black), para. 16, 102 and 131.

49 Cost of equity = Risk-free rate + Beta × MRP = 0.05 + 0.8 × 0.07 = 0.05 + 0.056 = 10.60%.

50 Cost of equity = Risk-free rate + Zero beta premium + Beta × (MRP – Zero beta premium) = 0.05 + 0.0334 + 0.8 × (0.07 – 0.0334) = 0.0834 + 0.8 × 0.0366 = 0.0834 + 0.0293 = 11.27%.

## Use of models other than the SBL CAPM to determine the cost of equity allowance

## 5.5 The Fama-French Model

### 5.5.1 Development and implementation

The Fama-French model[51] was developed in response to another empirical result that runs counter to the implications of the CAPM. Researchers observed that high book-to-market stocks earned returns that were too high compared to what is implied by the CAPM.[52] This is another result – like the low beta bias – that has never been overturned. It has persisted over time and across markets.[53]

The Fama-French model was developed in order to generalise this empirical result. In order to establish a model of how assets are priced in general, it is necessary to have an idea of the risks that are relevant to the pricing of all assets. The book-to-market ratio is a characteristic that can be used to identify stocks likely to earn high or low returns. But an asset pricing equation specifies an expected return as a function of risk factors and exposure to those risk factors. Fama and French (1993) augmented the CAPM with the additional risk factors SMB (i.e., a 'small minus big' premium) and HML (i.e., 'high minus low' premium), and exposure to those factors is measured with the coefficients $s$ and $h$.

The Commission has previously expressed concerns with the Fama-French model. One concern is the implementation problem; the Fama-French model requires measurement of more risk factors and exposure to those risk factors. This is not a material problem. The Commission is already making estimates of beta risk exposure from stocks listed in the UK, the US, Australia and New Zealand. The cost of equity from the Fama-French model can be estimated from exactly the same set of firms. We have previously estimated Fama-French factors for Australian-listed stocks, factors are already available for US-listed stocks, and the same analysis can be conducted for stocks listed in the UK and New Zealand. There is no technical impediment to estimating the parameters to the Fama-French model.

There can be disagreement over the exact composition of the SMB and HML factors. The point made by Michou, Mouselli and Stark (2014) is that the analysis of the Fama-French model can differ depending on which stocks are allocated to portfolios of small market capitalisation stocks, big market capitalisation stocks, high book-to-market stocks, and low book-to-market stocks.

Yet the other implication of the same research paper is that, in general and however classified, high book-to-market stocks have earned higher returns than

51 Fama and French (1993).

52 Fama and French (1992).

53 Fama and French (1998); Brailsford, Gaunt and O'Brien (2012); Michou, Mouselli and Stark (2014).

low book-to-market stocks. The overall empirical result, that has important implications for the cost of equity for an energy network, has never been overturned.

The Commission refers to the possibility that the results of Fama and French (1993) are due to data mining, leaving the possibility that the results are due to statistical artefacts of the data.[54] This concern is not valid.

Whilst there remains debate about the relative usefulness of particular asset pricing models to explain what factors affect stock returns,[55] over the 22 years since the publication of the initial Fama-French paper, numerous investigations in a range of countries have found the same empirical result to hold. The key empirical result that needs to be confronted by the Commission is not a matter of chance. On average, high book-to-market stocks systematically and consistently earn higher returns than predicted by the CAPM.

### 5.5.2 Theory

#### *Over-arching theories of asset pricing*

This brings us to the second objection to the Fama-French model by the Commission, that the model is based upon weak theoretical foundations. This concern is overstated, and essentially relies upon the same possibility of a chance result that was present in early criticism.

The results of Fama and French (1993) led to a substantial body of literature devoted to theoretical reasons for their empirical result. Those theoretical explanations are based upon the asset pricing theories already developed in the 1970s – the intertemporal CAPM (Merton, 1973) and the arbitrage pricing theory (Ross, 1976). The Commission's suggestion that the Fama-French model is without theoretical foundation is incorrect and unrepresentative of this body of work.[56]

The general theoretical foundation for the Fama-French model is the same as for the CAPM. Both models posit that there is a linear relationship between the expected return of a particular stock and the expected return of a mean-variance efficient portfolio. The only difference is that the CAPM (as implemented in practice) assumes that the relevant stock market index is mean-variance efficient, whereas the Fama-French model posits that the stock market index needs to be

54 Commission (2010), para. H2.25, pp. 400 to 401.

55 Lewellen, Nagel and Shanken (2010) make the point that it is necessary to think carefully about tests of asset pricing models, in particular the explanatory power (R-squared) that we could observe by chance, and manner in which portfolios are formed to test asset pricing equations.

56 Discussion of the general theories of the intertemporal CAPM and the arbitrage pricing theory is contained in section 2 of SFG Consulting (2014 FF).

supplemented by two additional factor portfolios to produce a mean-variance efficient portfolio.

The development of the Fama-French model can be viewed as a response to the empirical rejection of the CAPM on the basis of evidence that risks other than systematic risk are priced (that is, that the relevant stock market index as a single factor is insufficient). The extensive set of perfect market assumptions that are required for the CAPM to hold, and which do not hold in the real world, have two important implications. First, in a world with real market imperfections, in general, risks other than market risk will be priced (i.e., additional factors will be necessary, because in imperfect capital markets there is no reason to expect that the market will be mean-variance efficient). Second, the simple relation between mean return and market beta will no longer hold. In short, in real-world markets, multiple risks are likely to be reflected in asset prices, and the empirical evidence suggests that the SMB and HML factors are the best available proxies for those risks.

The existence of market imperfections should lead us to expect that risks other than market beta are likely to be priced. The next question is whether there is a body of theory to support the use of the particular factors that Fama and French have identified. For over 20 years researchers have developed and built on theories that explain why the two Fama-French factors explain stock returns.

The theoretical work on the Fama-French model explains the size and book-to-market factors in terms of a number of risks that could be priced by the market. There is debate amongst researchers about what risks are reflected in the size and book-to-market factors. But debate about alternative theoretical explanations does not mean that risks are not priced by the market. It simply means that there is more than one possible explanation that is consistent with the empirical evidence.

### *Distress*

One explanation for the persistent returns performance of high book-to-market stocks is the risk of financial distress. Chan and Chen (1991) argued distressed firms are more sensitive to changes in economic conditions and documented that distressed firms, as proxied by dividend reductions and leverage, earned relatively high returns. Thus, they were able to provide an explanation as to why small firms earn high returns – these firms were more likely to have experienced dividend reductions and be highly leveraged. When Fama and French (1992) showed that stocks with high book-to-market ratios earned relatively high returns, they proposed this could be due to the decrease in market value associated with lower earnings prospects for those firms in distress. The researchers continued to attribute the empirical evidence to distress risks in subsequent papers (Fama and French, 1995; and Fama and French, 1996).

The explanation put forward here for the average positive return to HML, is that fluctuations in HML proxy for changes in investors' assessment of the prospects of firms more at risk of distress. If HML falls during the month, it means that the market has taken a more pessimistic view on economic conditions, and high book-to-market firms are relatively more likely to be exposed to that downturn. This is the reason for modelling the firm's exposure to HML, reflected in the *h* coefficient. If HML proxies for the market's reassessment of the prospects of firms more exposed to economic conditions, then *h* captures the exposure of the firm to the HML risk factor.

One test of whether distress can explain why HML is a priced risk factor was performed by Vassalou and Xing (2004). The researchers measured the default risk of individual stocks using a model developed by Merton (1974). Note that the risk of default is a relatively more extreme outcome of the risk of distress. A firm can be in economic distress even if it has no debt and therefore no risk of default. But on average firms with debt at a higher level of distress would be expected to also be at more risk of default. The Merton measure of default risk is the basis behind the credit ratings of Moody's KMV. Default risk is determined primarily by market value leverage and the volatility of asset returns. It is a more timely measure of default risk than credit ratings based upon financial ratios because recent stock price movements are reflected in the leverage and volatility estimates.

The researchers measured how much of the variation in portfolio returns can be explained by stocks' size and book-to-market ratio, once a measure of default risk was incorporated. Their data shows that, in general, stocks with high book-to-market ratio earn higher returns than stocks with low book-to-market ratio, but this difference is largest amongst small stocks with the highest likelihood of default. This means that, in part, the variation in the HML factor over time will proxy for the market's assessment of conditions leading to an increased risk of distress, and the level of the HML factor on average represents compensation for this risk exposure.

This evidence shows that one reason for the explanatory power of SMB and HML is, in part, the risk of distress being priced. The evidence supports one theoretical reason why the Fama-French factors have performed well in explaining stock returns. If we ignore these factors we likely ignore an element of priced risk.

### *Exposure to changes in expectations for economic growth*

A second possible explanation for the Fama-French model is that the book-to-market ratio is a proxy for exposure to changes in expectations for economic growth. There are two theories of asset pricing that are consistent with the Fama-French model, namely the arbitrage pricing theory and the intertemporal CAPM. The latter theory says that investors do not simply care about expected wealth at

## Use of models other than the SBL CAPM to determine the cost of equity allowance

the end of one investment period. It says that investors care about wealth and economic conditions at the end of this period. So investors will pay more for assets that provide them with a hedge against adverse economic conditions at the end of their investment.

Vassalou (2003) provides empirical evidence consistent with this theory. The test in the study is whether returns to SMB and HML are proxies for news about GDP growth. To perform this test, the researcher first forms a prediction for GDP growth each year, based upon the relationship between GDP growth and variables that capture macroeconomic conditions, as well as returns on stock and bond portfolios. The second step is to test whether stock returns can be explained equally as well by the expectation for GDP growth, as by the SMB and HML factors. This turns out to be the case – the prediction for GDP growth seems to explain stock returns about as well as the SMB and HML factors.

The evidence shows that one possible reason for the explanatory power of SMB and HML is that, in part, investors care about GDP growth and the prices of different assets respond differently to news about GDP growth. The evidence suggests one theoretical reason why the Fama-French factors perform well is that they are correlated with news about GDP growth.

### *Asymmetric exposure to market conditions*

A third explanation for the book-to-market effect is that high book-to-market stocks experience different exposure to market risks depending upon whether market expectations for volatility are high or low. This is referred to as asymmetric exposure to market conditions. The theory is that, because high book-to-market firms have most of their value associated with tangible assets, they are exposed to economic downturns because it is difficult to reduce investment in tangible assets or to assign those assets to alternative uses (Zhang, 2005).

This theory was tested empirically by Petkova and Zhang (2005). In that study, the researchers measured the relationship between monthly values for HML and market returns. They estimated a beta (i.e. the market risk exposure) for the HML portfolio under periods of different market conditions. The results show that the HML portfolio has negative exposure to market returns during "good" times and positive exposure to market returns during "bad" times. This means that, when investors are most concerned about risk (the investors are pessimistic, as they would be in a recession) holding a high book-to-market portfolio increases their exposure to market returns. This means that a high book-to-market portfolio more aligns their portfolio with the market at the very time when investors would prefer less market exposure. When investors are less concerned about risk (the investors are optimistic, as they would be in an expansion), holding a high book-to-market portfolio reduces their exposure to market returns. This means a high book-to-market portfolio lessens investors'

exposure to market returns, precisely when they have more appetite for risk. This is the basis for the term "asymmetric exposure." The systematic risk exposure of HML is not constant across periods when investors prefer more to less risk.

The theoretical discussion presented above can be disaggregated into the general theories of the intertemporal CAPM and the arbitrage pricing theory, and three specific theories discussed immediately above – distress risk, exposure to changes in economic growth, and asymmetric exposure to economic conditions. This is not an exhaustive list of specific theoretical explanations for the performance of the Fama-French model. It represents three prominent theories that have empirical support. In the two decades since the publication by Fama and French (1993) an exhaustive literature has been devoted to theoretical explanations for the explanatory power of SMB and HML.

### 5.5.3 The need to reach conclusions

The debate over the potential adoption of the Fama-French model highlights the importance of reaching evidence-based conclusions. The Commission faces a well-established empirical result, that high book-to-market stocks earn high returns, relative to what would be expected under the CAPM. For energy networks, it is likely that they will have positive exposure to the HML factor, and therefore the cost of capital will be higher under the Fama-French model compared to the SBL CAPM.

The Commission should consider what is actually behind the empirical evidence:

- The book-to-market effect could be due to chance, which we consider highly unlikely given that it is not contained to any particular time period or market, and researchers today are generally trying to explain what risks are proxied by HML factor exposure, not establish that the book-to-market effect was a statistical fluke;
- The book-to-market effect could be due to investors persistently paying too much for stocks with high market-to-book ratios because of optimistic growth expectations. Yet this would represent such an extreme violation of market efficiency that the CAPM could no longer be relied upon. It cannot simultaneously be so easy to earn positive abnormal returns, just by holding a portfolio of low book-to-market stocks, yet the market be so efficient that the CAPM holds or indeed that market prices can be relied upon in any part of the regulatory process; or
- The book-to-market effect could be due to there being one or more risks proxied by exposure to the HML factor, a result that is explained by general theories of asset pricing (the arbitrage pricing theory and the intertemporal CAPM), and some specific applications relating to financial distress, exposure

## Use of models other than the SBL CAPM to determine the cost of equity allowance

to changes in economic growth and asymmetric exposure to market conditions.

If the Fama-French model incorporates a priced risk factor, and the model is ignored in estimating allowed returns, the allowed returns will be below the true cost of funds. Given that we have the ability to estimate the parameters of the Fama-French model, and the returns performance of high book-to-market stocks has not disappeared because it was a statistical fluke, the model should not be disregarded on the basis that another model (the CAPM) is easier to implement and the theory is easier to explain. There will be a material component of the equity risk premium that will not be captured. So the Commission should reach a conclusion on what the book-to-market effect represents and how it should be dealt with in the cost of capital IM.

Our view is that the Fama-French model captures a relevant, priced risk and that a more reliable and complete estimate of the cost of equity will result from reliance on the SBL CAPM, the Black CAPM and the Fama-French model. Further, both the cost of equity estimates from the Black CAPM and from the Fama-French model can be adapted easily to the tax situation in New Zealand, merely by estimating the equity risk premium associated with each model.

## 5.6 Conclusion on asset pricing models

The use of three asset pricing models to estimate the cost of equity – the CAPM, Black CAPM and Fama-French model – has a theoretical and empirical basis. The sole reliance on the CAPM to estimate the cost of equity, if continued, would essentially be based entirely on conviction or belief. The weight of empirical evidence suggests that the CAPM, as implemented by the Commission, will underestimate returns on low beta stocks, and stocks that have positive exposure to the HML factor. These characteristics are pronounced for energy networks, and so it is prudent to estimate the cost of equity by relying upon output from all three models. We have demonstrated previously that the cost of equity from these models can be estimated, and so there is no practical hurdle to adopting them in New Zealand. Much of the Commission's data already used to estimate the cost of equity comes from other markets already. The appropriate way to derive a reliable and complete estimate of the cost of equity is to place reliance on the CAPM, the Black CAPM and the Fama-French model.

# 6 Beta estimation

## 6.1 The Commission's approach to estimating beta in the current cost of capital IM

The cost of capital IM adopts an estimate of the asset beta of 0.34[57] and leverage of 44%.[58] This results in an estimate of the equity beta of 0.61.[59,60]

The asset beta estimate of 0.34 results from analysis of 79 firms listed in New Zealand (2), Australia (6), the UK (1) and the US (70).[61] The Commission estimated the equity beta for each firm by regressing stock returns on market returns. The equity beta estimates are compiled using a number of five-year periods and compiled separately using monthly stock returns and weekly stock returns. While there is considerable discussion of submissions, the ultimate conclusion of the Commission is informed by the following quantitative analysis.

The Commission compiled asset beta estimates using eight, five-year periods ending each year from 1995 to 2010. For each firm, the Commission estimated an asset beta from monthly returns and an asset beta from weekly returns, based upon an average of the eight asset beta estimates relating to each five-year period.[62] The Commission computed an average asset beta estimate across all firms 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).[63]

The Commission stated that it adopted an asset beta estimate of 0.34, rather than 0.30, because the Commission considers it prudent to adopt the asset beta proposed in its Draft Reasons Paper. In justifying this choice, the Commission referred to the variability in the beta estimates and the imprecision with which beta can be estimated.[64]

---

57 Commission (2010), para. 6.5.22, p. 158; para. 6.7.7, Table 6.4, p. 167; and para. H8.1, p. 508.

58 Commission (2010), para. 6.6.14, p. 165; and para. H8.1, p. 508.

59 Commission (2010), para. 6.6.16, p. 165; and para. H8.1, p. 508.

60 The asset beta and the equity beta are related via the following equation. Equity beta = Asset beta × (1 + Debt ÷ Equity) = 0.34 × (1 + 0.44 ÷ 0.56) = 0.34 × 1.79 = 0.61.

61 Commission (2010), Table H17, pp. 516 to 518.

62 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.

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

64 Commission (2010), para. H8.71, p. 525.

## 6.2 Weaknesses with the current approach to estimating beta

### 6.2.1 Introduction

As explained in section 5, the SBL CAPM is an incomplete way of characterising the risk-return relationship. Therefore, whilst it is sensible for the Commission to consider ways of improving its beta estimates, these considerations should be made within the broader context of reviewing the Commission's emphasis on the SBL CAPM, and the reliability of beta estimates compiled from regressions of stock returns on market returns.

The Commission has taken steps to mitigate the risk that its beta estimates are affected by a small number of firms with spurious beta estimates. It uses a reasonably large sample of listed firms with exposure to listed energy networks, and estimates beta using a long time series of returns.

Yet there remain a number of areas in which the estimation of the cost of equity can be improved, including consideration of the estimation, and interpretation of beta estimates. We consider these issues both in relation to the dataset already analysed by the Commission (historical stock and market returns), the Commission's inference of that information, and alternative information that could prove useful in estimating the cost of equity.

### 6.2.2 Beta estimates from stock returns and market returns

The Commission relies upon beta estimates compiled from analysis of stock returns on a weekly basis and a monthly basis. On average, the asset beta estimates from weekly returns are 0.04 higher than the asset beta estimates from monthly returns (0.32 versus 0.28) and 51 out of 76 firms (67%) have higher asset beta estimates when weekly returns are used. This does not necessarily mean there is anything particularly informative about the monthly or weekly returns. It could simply be the case that there are some influential market movements that affected particular months or weeks that led to the different asset beta estimates.

#### *Reference day sampling errors*

The imprecision of beta estimates from regressions of stock returns on market returns is highlighted by the variability of asset beta estimates for individual firms, when considering weekly versus monthly returns. At one extreme, Horizon Energy has an asset beta estimate of 0.38 when monthly returns are used and an asset beta estimate of 0.16 when weekly returns are used, a difference of +0.22. At the other extreme, Hastings Diversified Utilities has an asset beta estimate of

0.17 based upon monthly returns and 0.54 derived from weekly returns, a difference of −0.37.[65]

Some of the 'noise' in these estimates derives from the choice of a particular set of reference days used to calculate the stock and market returns used to estimate betas. For instance, when deriving weekly beta estimates, the weekly returns associated with the individual stock or the market as a whole could have been derived by measuring the percentage change in the stock price and the stock index between consecutive Mondays (i.e., the Monday-to-Monday return, based on Mondays as the reference day). Alternatively, the chosen reference day could have been Wednesday, in which case all returns employed in the regression used to estimate betas would have been measured by taking the percentage change in stock prices and the stock index between consecutive Wednesdays. The two sets of returns series will almost certainly differ – in some instances substantially. This, in turn, will result in different estimates of beta depending on the chosen reference day. The variation between estimates due to the choice of reference day is a form of sampling error that introduces noise into the estimation process.[66]

One easily implementable way to improve the reliability of beta estimates is to simply repeat the analysis 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 means that weekly beta estimates are compiled five times, using Monday-to-Monday returns, Tuesday-to-Tuesday returns and so on, rather than relying only on Friday-to-Friday returns. In prior work we have observed that, on average, the difference in equity beta estimates for a given firm can be substantial, merely by selecting a different reference days when computing the returns employed in the regressions used to estimate betas.[67]

With respect to monthly returns, an alternative is to compile four-weekly returns, which means there is a standardisation of the returns interval from one returns period to the next (that is, returns over 28 calendar days, rather than calendar days of 28 to 31). Then, the analysis can be completed 20 times, using a different start and end point for the analysis.

---

65 Commission (2010), Table H18, pp. 521 to 523.

66 The estimation error associated with different reference days was documented by Acker and Duck (2007) and Dimitrov and Govindaraj (2007). Acker and Duck show that estimation error associated with different reference days is due to sampling error – using one reference day to compute returns gives different answers than using another reference day to compute returns. It is not due to some anomaly such as the turn of the month effect.

67 As one illustration, we previously showed that when equity beta estimates are compiled using four-weekly returns (which means there are 20 different start points in a four week period for computing returns) on average the difference between the highest and the lowest equity beta estimate for any individual firm was 0.32, for a sample of 56 US-listed energy network firms. This occurs entirely to the random selection of the start point for the four week returns computation. (SFG Consulting, 2013 Risk, p.4).

Having derived beta estimates using all possible reference days, these estimates could be averaged. 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. This approach is implemented easily and would result in more precise beta estimates.

#### *Illiquidity of individual stocks*

The current cost of capital IM recognises that some of the stocks in the Commission's sample may be thinly traded, and this could affect the beta estimates. The Commission deals with this problem by removing the smallest firms from its sample. This is a somewhat 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.

There are better ways of taking account of the potential risks of illiquidity than simply adopting a minimum market capitalisation of US$100 million.[68] 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. The equation is presented below.

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

In prior work we identified 7 out of 77 potential comparable firms that were noticeably less liquid than other comparable firms using this metric.[69]

### 6.2.3 Unreliable and incomplete measure of risk

#### *Introduction*

The Commission has formed the view that the best estimate of the cost of equity will result from the following two methodological choices:

- application of the SBL CAPM (with no consideration of alternative cost of equity estimates); and
- estimation of the risk parameter within the SBL CAPM (beta) with regressions of stock returns on market returns (with no consideration of alternative data that could be used to estimate beta).

---

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

69 SFG Consulting (2013), p. 9.

No other datasets or estimation approaches are used in estimating risk. The Commission's reliance on the SBL CAPM is predicated on its general use in corporate finance practice, and its support in theory. We consider these issues separately in Section 5.

There is little evidence that the Commission's sole measure of equity risk exposure actually generates estimates of risk that are useful in determining which firms are more or less risky than other firms. From the cost of capital IM itself, there are four issues that imply that the regression-based estimate of beta is an unreliable and incomplete measure of risk that is relevant to the cost of equity. These issues are considered below. We point out that:

- The Commission identifies a body of theoretical work suggesting that different forms of regulation matter for risk – yet beta estimates do not differ according to different forms of regulation.
- The Commission itself adopts a beta premium of 0.10 for gas pipeline businesses relative to electricity distribution businesses, yet beta estimates do not differ between firms that are predominantly gas versus electricity businesses.
- The Commission estimates that a typical energy network business has 44% gearing and adopts a BBB+ credit rating in its IM, and yet the equity beta estimate for an electricity distribution business is only 0.54. Why would the equity holders be exposed to so little risk when a typical firm with the same proportion of debt financing would have twice the equity risk exposure?
- There is little or no relationship between regression-based beta estimates and portfolio returns, and there are now decades of returns data over which beta estimates should line up with average returns.[70]

The implication is that the regression-based estimate of beta is not a reliable and complete measure of risk. The Commission should consider whether the use of additional data, and the use of additional risk factors, can improve the reliability of the cost of capital IM's estimates of the equity risk premium.

### *Returns to stocks with different beta estimates*

The lack of any discernible relationship between the form of regulation and beta estimates is not surprising if we consider the broader evidence on the relationship between beta estimates and historical stock returns. The empirical evidence is

[70] As discussed below, the Commission relies on a research paper by Pettengill, Sundaram and Mathur (1995) to counter this point. However, as we explain in the section entitled 'Returns to stocks with different beta estimates', below, that paper suffers from a methodological flaw that results in the erroneous finding of support for the CAPM (based on the authors' ability to derive a relationship between regression-based beta estimates and portfolio returns).

that regression-based beta estimates show little or no ability to explain why some stocks earn higher returns than others. This has two interpretations, and both interpretations have a reasonable basis. Either:

- the SBL CAPM represents an incomplete model of expected returns; or
- the regression-based beta estimate that is inserted into the SBL CAPM is estimated so poorly that it does not capture the full extent of systematic risk.

A number of papers report the basic result that if portfolios of stocks are ranked by their beta estimates, on average the low beta portfolios earn higher returns than predicted by the CAPM; and the high beta portfolios earn lower returns than predicted by the CAPM. Over time the same result has been reported over and over again.[71]

The use of this empirical evidence to cast doubt on the usefulness of the CAPM, populated with regression-based estimates of beta, is called into question by the research of Pettengill, Sundaram and Mathur (1995), which in turn is relied upon by the Commission.[72] The point made by Pettengill, Sundaram and Mathur is that a better fit between beta estimates and portfolio returns is obtained if we partition the sample into periods in which market returns are above the risk-free rate, versus periods in which market returns are below the risk-free rate. The reason this is important is because if market returns are below the risk-free rate, the CAPM says that a low beta portfolio should earn higher returns than a high beta portfolio. Once Pettengill, Sundaram and Mathur split the sample according to months of market returns above and below the risk-free rate, they do find a directional relationship between portfolio beta estimates and returns that is predicted by the CAPM.

However, there is a flaw in the research method that leads to this empirical result being almost certain to occur in the data, even if there was no relationship whatsoever between beta estimates and expected stock returns. The point made by Cooper (2009) is that the allocation of the sample into time periods on the basis of realised market returns leads to this mechanical (even tautological) result.

It is relatively easy to explain. Suppose that we know for certain what the beta is for each stock (or portfolio), but that in reality the expected return for each stock (or portfolio) is independent of beta. The return on each stock (or portfolio) in a given period could be characterised by the following equation.

Stock return = Predicted stock return, conditional upon the market return + Noise uncorrelated with market returns

71 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).

72 Commission (2010), para. 6.4.1, p. 151; and para. H2.22, p. 400.

= Expected market return + Beta × (Market return – Expected market return) + Noise uncorrelated with market returns

In this equation, the relationship between beta estimates and the expected stock return is flat – the CAPM does not hold. But when the market goes up we still observe high beta stocks earn high returns, and when the market goes down we still observe high beta stocks earn low returns. The model could be improved by adding risk factors other than market risk, but that is not the relevant point. The relevant point is to show that we will observe the result reported by the researchers, even for a situation in which beta is entirely independent of expected returns on a stock or portfolio.

Now suppose the risk-free rate is 6%, the expected market return is 12% and the standard deviation of market returns is 20%. If the market does really well – say earns a return one standard deviation above the mean (32%) the predicted return (conditional on that market return) on a portfolio with beta of 0.5 is 22%.[73] In contrast, a portfolio with beta of 1.5 has a predicted return of 42%.[74]

In the situation in which the market does really badly – say earns a return one standard deviation below the mean (−8%) the predicted return (conditional on that market return) on a portfolio with beta of 0.5 is 2%.[75] The contrasting predicted return for a portfolio with beta of 1.5 is −18%.[76]

This means that the expected return on any stock is equal to the market return and is entirely independent of its beta estimate. But if we separate the sample into those time periods in which the market earned high returns versus those periods in which the market earned low returns, we will find that the high beta stocks earned relatively high returns when the market did well; and earned relatively low returns when the market did poorly. We will end up finding support for the CAPM even when the model does not hold.

To illustrate this, we performed a simulation analysis in which we compiled predicted returns for 11 portfolios with beta estimates of 0.5 to 1.5 in increments of 0.1, and generated expected market returns at each 0.01% increment of a normal distribution.[77] We retained the risk-free rate of 6%, the expected market return of 12% and the standard deviation of returns of 20%. This means there is a 38% chance the market return is below the risk-free rate and a 62% chance the market return is above the risk-free rate. We then compiled the average returns to

---

73 Predicted stock return = 0.12 + 0.5 × (0.32 – 0.12) = 0.12 + 0.5 × 0.20 = 0.12 + 0.10 = 0.22.

74 Predicted stock return = 0.12 + 1.5 × (0.32 – 0.12) = 0.12 + 1.5 × 0.20 = 0.12 + 0.30 = 0.42.

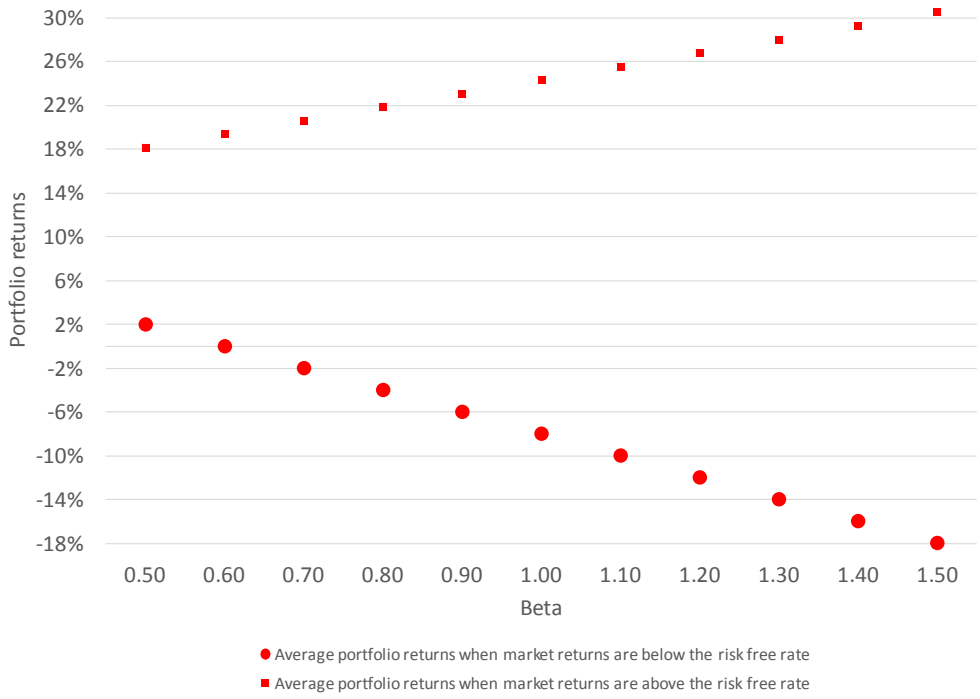
75 Predicted stock return = 0.12 + 0.5 × (−0.08 – 0.12) = 0.12 + 0.5 × −0.20 = 0.12 − 0.10 = 0.02.

76 Predicted stock return = 0.12 + 1.5 × (−0.08 – 0.12) = 0.12 + 1.5 × −0.20 = 0.12 − 0.30 = −0.18.

77 This means we generate the market return at the 1/10,000th percentile, the 2/10,000th percentile and so on for 9999 possible market return outcomes.

each portfolio in the two different market circumstances (market returns above or below the risk-free rate) and plot the average returns in Figure 5.

Figure 5: Illustration of average returns to high and low beta portfolios even if the CAPM does not hold




*Source: Frontier Economics*

Figure 5 shows the positive association between beta and returns when the market return is above the risk-free rate, and the inverse relationship between beta and returns when the market return is below the risk-free rate. This is the same result reported by Pettengill, Sundaram and Mathur (1995) but occurs when the data has been generated from a model in which beta is irrelevant to expected returns.

We acknowledge the point being made by the researchers about the direction of market movements. But the actual results reported in the paper cannot be used in support of the CAPM, because they will occur even if the CAPM does not hold. So we are left with the evidence from analysis of returns over decades that, on average, low beta stocks earn higher returns than the theory of the CAPM says they should. If we observed the same inability of credit ratings to partition bonds into different returns cohorts we would question the usefulness of credit ratings. By the same token we should start to question the ability of regression-based estimates of beta as a metric to distinguish between stocks with high and low expected returns.

The point being made by Pettengill, Sundaram and Mathur (1995) – that the market movement needs to be considered in evaluating the CAPM – was an explicit part of analysis we performed in relation to the Black CAPM.[78] Our task in that case was to estimate the zero beta premium, the difference between the expected return on a zero beta asset and the risk-free rate. This is an empirical exercise in measuring the actual relationship between beta estimates and stock returns, as opposed to what the relationship should be under the theory of the CAPM.

The implication is that, consistent with empirical evidence across equity markets and over decades of stock returns, that actual returns on low beta stocks are above those predicted by the CAPM. There is still some positive association between beta estimates and returns (provided there is no difference in size and book-to-market ratios in each portfolio) but there is not the same relationship between beta and returns that the CAPM implies.

In considering returns across markets and over time, empirical research has moved well beyond the point at which this result could be considered a chance outcome, likely to be corrected if only more data were available. Now we are left with two troubling aspects of beta estimation from regressions of stock returns on market returns:

- The Commission cites extensive theoretical research which argues for increased risk to equity holders as regulation becomes more incentive based – but no evidence that regression based estimates of beta show this relationship.
- There is no reliable evidence that stock returns approximate the expected returns from the CAPM and in particular, low beta stocks earn higher returns than predicted by the CAPM.

So this provides some reason to reconsider the risk estimate. It is time to reconsider whether simply regressing stock returns on market returns generates a reliable, and complete, measure of the risk exposure of equity holders.

These are not the only two anomalous results that cast doubt on the beta estimate as a measure of risk. The following two questions cannot be answered by relying on regression-based estimates of beta as the sole risk measure that is relevant for the cost of equity.

### *Leverage*

First, if the regression-based beta estimate is the only relevant risk measure, and if beta estimates are so low, why isn't the leverage of the comparable firms higher? The Commission estimates the average leverage of comparable firms at

78 SFG Consulting (2014 Black).

44%[79] on a market value basis, and adopts a credit rating assumption of BBB+.[80] According to the Commission, at leverage of 44% the equity holders are still exposed to low risk (an asset beta of 0.30 implies an equity beta of 0.54)[81] but this is the leverage that supports a BBB+ credit rating. The typical firm in the market takes on leverage that brings the beta estimate to one, and also has an investment grade credit rating. So if the regression-based beta estimate is a complete measure of risk, why would the equity holders in an energy network business be exposed to less than 60% of the risk of a typical equity holder, yet the debt holders have roughly the same risk as the typical debt holder?

This does not make sense. A possible explanation is that the credit rating reflects the total volatility of returns, whereas beta reflects only the systematic component of returns. However, all the reasons mentioned by the Commission as to why an energy network would have a low beta also suggest that total volatility of returns is low. With reference to electricity, the Commission refers to stable demand, no real substitutes and no or limited competition.[82] So the question remains, if it really is the case that the regression-based estimate of beta is a reliable and complete measure of risk for equity holders, wouldn't we expect the businesses to sustain even higher levels of gearing and still be able to maintain an investment grade credit rating? Our view is that the regression-based beta estimates are not a reliable and complete measure of risk, and so an asset beta estimate of 0.30 omits a material source of relevant risk.

### *Gas pipelines*

Second, in the Commission's own decision, it allocates an additional 0.10 to the asset beta estimate of a gas pipeline business, compared to an electricity distribution business, because of the incremental risks associated with a gas pipeline.[83] The basis for this decision is the Commission's acceptance of advice from Lally, who identifies that gas pipeline businesses had options to expand the network, gas is often an intermediate product which leads to increased elasticity of demand, some gas is used to produce the variable supply of electricity leaving gas demand more exposed to economic shocks, and only 6% of gas demand relates to residential use.[84]

Yet in the Commission's analysis of beta estimates from listed firms there is no evidence of any difference in empirical beta estimates amongst gas and electricity

---

79 Commission (2010), para. 6.6.14, p. 165.

80 Commission (2010), para. 6.3.24, p. 141.

81 The Commission's asset beta estimate used in the IM is 0.34, but this is due to the Commission retaining its beta estimate from its draft decision.

82 Commission (2010), para. 6.8.1, p. 169.

83 Commission (2010), para. H8.181, p. 545.

84 Commission (2010), para. H8.172, p. 543.

firms.[85] The Commission concluded that there was sufficient theoretical evidence to adopt a different estimate of the cost of capital for a gas pipeline compared to an electricity distributor. However, the single quantitative measure of risk failed to reflect the differences in risk characteristics between gas and electricity networks that the Commission accepted. The reason this occurs is because the risk measure – the regression-based estimate of beta – is not a reliable and complete measure of the risk that equity holders are exposed to and which is incorporated into equity value. For the avoidance of doubt, we are not arguing that the risk profiles of gas and electricity networks do not differ. Rather, we are arguing that the single measure of risk used by the Commission (i.e., the equity beta) is unable to identify any differences that may exist.

### 6.2.4 Models, information and estimation

In the sections above, we make the point that the Commission's sole risk estimate for equity holders is an unreliable and incomplete measure of risk. Even if the Commission mitigates estimation error in the relationship between stock returns and market returns, incorporating the regression-based estimate of beta into the SBL CAPM will not lead to the cost of equity appropriately reflecting risks to equity holders.

There are a number of additional pieces of quantitative analysis that can be undertaken in order to form a more comprehensive estimate of the equity risk premium. In some instances, this involves making a direct estimate of beta using information other than stock returns and market returns. In other instances this may involve making a relative assessment of risk (analogous to the Commission's assessment that gas pipeline businesses have higher risk than electricity distribution businesses, albeit with more quantitative analysis). And in other instances this involves incorporating a risk factor outside the CAPM. We consider these three approaches in turn.

#### *Information other than regressions of stock returns on market returns*

Beta is an estimate of how stock returns move in association with market returns. Examining the past relationship between stock returns and market returns leads to one estimate of beta. But it is important to bear in mind that this is only a proxy for a parameter to be inserted into an equation. It does not necessarily reflect the risk exposure that is actually embedded in stock prices and therefore in the cost of equity.

One alternative way the beta proxy can be estimated is with reference to changes in accounting forecasts of earnings per share. Rather than regress changes in

85 Commission (2010), para. H19, p. 524.

stock prices on changes in index prices, regress changes in forecasts of stock earnings per share on changes in market earnings per share. This approach has been adopted in empirical research[86] and could provide cleaner estimates of beta risk than returns-based estimates.

This analysis builds upon research which began in the 1970s and 1980s in which researchers attempted to estimate systematic risk with reference to fluctuations in reported earnings. The reason this line of enquiry stalled is because reported earnings are so greatly affected by company-specific events relating to one particular reporting period, that the signal to noise ratio is very low. There are not enough firms and enough accounting periods for a reliable measurement of systematic risk to be made, amongst the large changes in earnings due to company-specific events.

This problem is less pronounced when we consider projections of earnings per share over periods of up to three years. While some changes in projected earnings are associated entirely with company-specific information, a greater proportion of the movement in earnings forecasts will be due to economy-wide news, in comparison to actual earnings releases.

Another alternative set of information that could be considered is the relationship between share prices, earnings and dividends, on an actual and forecast basis. This analysis could be done with reference to the dividend discount model (to make a direct estimate of the equity risk premium, and therefore the implied beta estimate); or could be done in an indirect manner by considering the earnings and dividend yields for a suite of companies with similar growth trajectories to energy network businesses.

Consider first the dividend discount model. The Commission is aware of the practice in the US of using the dividend discount model to estimate the cost of equity, rather than relying exclusively on an asset pricing equation like the CAPM.[87] The Commission is also aware of the challenge to implementing this approach – namely that the cost of equity is a function of whatever is assumed to be the projected dividend stream. Assume high dividend growth and the implied cost of equity is high; assume low dividend growth and the implied cost of equity is low. But some of the Commission's concerns in relation to the use of the dividend discount model are overstated, and others apply equally to the Commission's existing cost of equity estimation approach:

- The Commission makes the point that the dividend discount model can only be used to estimate the cost of equity for stable, mature firms, and for firms that pay dividends[88] – yet the sample of comparable firms the Commission

86 Da and Warachka (2009).

87 Commission (2010), para. 6.4.6, p. 145.

88 Commission (2010), para. H2.30, p. 402

relies upon to estimate beta is a sample of stable, mature firms that pay dividends. The need for a long time series of historical returns almost guarantees this. So there is no reason a dividend discount model estimate of the equity risk premium cannot be made for the same comparable firms that the Commission has used to estimate beta. There is imprecision in the projections for earnings and dividends that lead to the cost of equity estimates. But it is not the case that regression-based estimates of beta for these firms can be derived, but that the cost of equity from the dividend discount model cannot be derived.

- The Commission points out that good forecasts of dividends are essential, and that often earnings are used as a substitute for dividends under the assumption that dividends and earnings grow at the same rate. The Commission also refers to the limited forecasts of dividends available for New Zealand listed firms.[89] The Commission has already formed the view that reliance on firms listed in Australia, the UK, and the US provides sufficiently reliable information to estimate beta. So there is no reason to think that the Commission should only rely upon New Zealand listed firms to estimate the equity risk premium using earnings and share prices. As for the dividends and earnings projections, what we have is potential estimation error associated with a series of assumptions. This pales in comparison to the estimation error inherent in applying the CAPM, populated with regression-based estimates of beta. We know that the perfect capital markets assumptions of the CAPM do not hold, and so the issue is whether the CAPM is a sufficiently close approximation to reality to be useful in estimating the cost of equity. Regulators and other corporate finance practitioners understand this and continue to use the CAPM, despite there being scant evidence that the model generates cost of capital estimates that are high for high return stocks, and low for low return stocks. So on the one hand the Commission has doubts about one equation (the dividend discount model) because there is uncertainty over the right inputs, but has faith in another equation (the CAPM) despite there being considerable evidence that it does not have the right inputs.

- The Commission raises the concern that short-run growth estimates are often higher than growth in the economy, which would be nonsensical if extrapolated in perpetuity.[90] There is no reason to extrapolate high short-term growth rates in perpetuity, and as the Commission points out this problem can be mitigated with multi-stage models.[91] It should also be noted that the

89 Commission (2010), para. H2.30, p. 402.

90 Commission (2010), para. H2.30, p. 402.

91 Commission (2010), para. H2.30, p. 402.

growth in earnings per share of a listed company, or many listed companies, can exceed the growth rate in the economy for a very long time before the nonsensical outcome pointed out above is realised. What matters for a net present value computation is the series of cash flows over 100 years (after which the present value of expected cash flows is approximately zero). And we observe listed companies experience earnings per share growth at high rates for decades. Part of this growth is due to share buy backs, which necessarily imply lower dividends today as a trade-off for higher earnings later. There is no reason why a company's earnings per share cannot grow indefinitely at rates above economic growth, if that growth is partly fuelled by share repurchases.

- Finally, the Commission raises a question mark over the efficiency of financial markets.[92] The Commission's estimation of the cost of debt from bond prices is premised on the bond market being reasonably efficient. The Commission's estimate of the risk-free rate is premised on the government bond market being reasonably efficient. And the CAPM only holds in an efficient market. The issue is not whether the equity and bond markets are perfectly efficient. The issue is whether they are efficient enough to generate reliable estimates of the cost of capital. It is not reasonable to assume that the bond and equity markets are efficient enough to estimate yields on government bonds, yields on corporate bonds, and beta estimates, and efficient enough to rely upon the SBL CAPM as the only asset pricing model, but at the same time decide the equity market might not be efficient enough to use stock prices to estimate the cost of equity.

In this report we do not recommend the exact manner in which the dividend discount model should be applied to estimate the cost of equity for energy network businesses. Our point is that the assumptions required and estimation error inherent in applying the dividend discount model are likely to be no greater hurdle to overcome than those already implicit in the Commission's application of the SBL CAPM, populated with regression-based estimates of beta. A combination of estimating the equity risk premium via (1) regression-based estimates of beta, and (2) dividend discount model analysis, is likely to mitigate estimation error in the cost of equity estimate.

In addition, even if the dividend discount model was not used to make an explicit estimate of the equity risk premium, earnings yields and dividends yields could be used to infer an equity risk premium on the basis of a relative risk assessment. If regression-based estimates of beta are genuinely useful in estimating the cost of equity, we should observe:

- Other stable, low beta businesses having comparable earnings yields; and

92 Commission (2010), para. H2.30, p. 402.

- Other stable businesses with similar earnings yields having comparable low beta estimates.

If we observe a disconnect between earnings yields and beta estimates for other stable businesses, this tells us something about the usefulness of regression-based beta estimates for estimating the equity risk premium.

### *Consideration of risk factors outside the SBL CAPM*

The specific discussion of models outside the SBL CAPM is presented in section 5. But the discussion of the appropriate beta estimate cannot be conducted in isolation from consideration of alternative risk factors.

In the discussion above, we outline the anomalies which result from exclusive reliance on the SBL CAPM, populated with regression-based estimates of beta. Our conclusion is that the regression-based estimate of beta is an unreliable and incomplete measure of risk. There is extensive evidence over time and across markets that stocks characterised by a high book-to-market ratio earn higher returns than predicted by the CAPM. The early evidence led to the development of the Fama and French (1993) model. The HML factor represents, in an asset pricing equation, the additional risk factor that equity holders are exposed to. This is especially important for energy networks, which are characterised by high book-to-market ratios and which are therefore highly likely to have high exposure to the HML factor.

It is correct to say that there is disagreement over the precise nature of the risks that are encapsulated by the HML factor. But it is not correct to say that the CAPM has any claim to a profoundly better theoretical basis. The CAPM is a useful idea, developed five decades ago to think about risk in a portfolio context. Yet all this theory says is that if the assumptions of a perfect capital market are met (in particular, that investors have equal expectations for returns and risk of all assets, and that trading occurs in an efficient manner), then the only risk exposure encapsulated an asset pricing model is systematic risk. Yet as soon as these assumptions are violated there is the potential for several risk factors to be embedded in an asset pricing equation.

For most asset classes, it is possible to verify that our intuition regarding expected returns align with the realised returns outcome. Government bonds are perceived to have little risk, and historically have earned low returns. Corporate bonds are perceived to have moderate risk and historically have earned moderate returns. Equities have earned a premium above corporate bond returns, and emerging market equities, on average, have earned returns above developed market equities. Within the corporate bond market there is a very good relationship between credit ratings, yield to maturity, probability of default and recovery rate in the event of default.

Within the equity asset class, however, we do not have evidence that high beta stocks earn high returns and low beta stocks earn low returns. We do, however, have evidence that another stock characteristic, the book-to-market ratio, can be used to partition stocks into high and low return cohorts. In the Fama-French model itself, this is incorporated via a measurement of exposure to the HML factor.

On the one hand we have a measure of risk (regression-based estimate of beta) that suits a useful idea for thinking about expected returns, but which has not been shown to map onto realised returns. On the other hand, we have measures of risks (exposure to the HML factor, or the stock characteristic of the book-to-market ratio itself) which do allow us to differentiate between high and low return stocks, but with disagreement amongst researchers about the precise nature of the risks that are captured.

This suggests that the Commission needs to consider a cost of equity estimate that gives some consideration to the outcome from the CAPM, and some consideration to the cost of equity estimate from the Fama-French model. Otherwise, the Commission will persist with an approach to estimating the cost of equity which will lead to expected returns estimates that fall below the returns actually earned on listed stocks with the same beta estimates.

## 6.3 Reconsidering the equity beta estimate and the equity risk premium

In summary, the Commission's task is to make its best estimate of the equity risk premium. One approach to this task is to estimate beta via regression of stock returns on market returns, and then multiply the beta estimate by an estimate of the MRP. But this approach does not have to be the sole way in which the equity risk premium can be measured. If this method is retained as the sole approach to estimating the equity risk premium, the cost of equity will likely be understated.

The existing analysis of the equity risk premium can be supplemented with:

- Beta estimates compiled with reference to revisions to analyst forecasts, rather than relying exclusively on stock returns;
- Equity risk premium estimates compiled using the analysts forecasts of earnings and dividends, and adopting the dividend discount model;
- Consideration of the relative earnings yields and dividend yields of other stable companies with comparable beta estimates; and consideration of the beta estimates of other stable companies with comparable earnings yields and dividend yields; and

- Consideration of risk factors outside of the SBL CAPM, of which the most informative risk factor is likely to be the HML factor.

## Beta estimation

# 7 Issues raised by the High Court that are yet to be resolved

As the Commission noted in its problem definition paper, the High Court raised a number of issues that the Commission has not addressed yet:

- The leverage anomaly associated with the SBL CAPM;
- The term credit spread differential (TCSD); and
- The split cost of capital approach.

Given the direction from the High Court, we agree that the Commission should consider these issues as part of the IM review. However, these issues should not be given undue prominence. The first two issues above can be considered as part of other, broader topics identified earlier in this report. The third topic (on the split cost of capital approach) should be examined and dismissed quickly.

## 7.1 Leverage anomaly associated with the SBL CAPM

The first of these issues, the leverage anomaly, highlights clearly a weakness of the SBL CAPM. It is an indicator of why the Commission should not place exclusive, or even primary, reliance on a single model. We recommend this issue be considered as part of the broader topic of the extent to which the Commission should use other models, alongside the CAPM, to estimate the cost of equity allowance.

The Commission notes in its problem definition paper that:

> 266. Since the original decision we are have not been made aware of any:
>
> 266.1 Alternative approaches that can reflect both the NZ tax regime and resolve the leverage anomaly; or
>
> 266.2 Decrease in the practical application of the SBL CAPM by New Zealand equity analysts and investors.

The Commission seems to be assuming it needs to identify and use a single best model for the purposes of estimating the cost of equity. This need not be the case.

Rather, the Commission should recognise that:

- No model is perfect;
- All models, including the SBL CAPM, have weaknesses but generally have something to offer to the analysis; so

- It should use a combination of models rather than a single model (with an ambiguous method of 'cross-checking' using other models).

## 7.2 Term credit spread differential

The need for the TCSD arises because the Commission matches the assumed term of the borrowing to the length of the regulatory period, whereas it is efficient and prudent for some suppliers to issue long-term debt.

The Commission is correct that suppliers who have prudently issued long-term debt to manage refinancing risk should be adequately compensated, and this compensation should cover the higher debt premium associated with longer-term debt and the execution costs of interest rate swaps, used to match the supplier's re-pricing period to the length of the regulatory period. However, the Commission is incorrect to assert that:

> 270.4 The most practical method by which to achieve this outcome is to include a TCSD allowance.

If the Commission were to adopt a trailing average approach using a 10-year maturity assumption for debt issued by Transpower, that approach would ensure that:

- The cost of debt allowance aligns closely with the cost of debt of a supplier engaged in a prudent and efficient debt management strategy (which includes issuing long-term debt); and
- Suppliers are compensated appropriately for efficient debt financing, including the higher debt premium associated with longer-term debt.

If the Commission adopts such an approach, it would not have to provide a separate TCSD allowance. However, there would be a strong case to continue providing a TCSD allowance if:

- The Commission adopts a trailing average approach with shorter (e.g. 5 year) debt maturities; or
- Chooses to retain its current 'rate on the day' approach using a 5 year assumed debt maturity.

In any event, this issue should be dealt with as part of the considerations relating to the indexation of the cost of debt allowance (covered in section 3).

## 7.3 Split cost of capital approach

In our March 2014 report to Transpower, we commented on the split cost of capital (i.e., 'two-tier' WACC) approach proposed by MEUG.[93] Our analysis showed that the split cost of capital approach has been considered extensively in the UK, but no regulator there has, to date, adopted the approach.

The Commission notes in its problem definition paper that the QCA has recently considered the split cost of capital approach. We noted in our March 2014 report that despite having gone through an extensive process of considering the approach, the QCA has not adopted it.

Further, we noted that the QCA had concluded that:

- The proposal (in its full form) has not been adopted by any regulator;
- There are a number of implementation issues associated with the split cost of capital approach; and
- It would be premature to adopt the approach unless these implementation issues can be resolved.

The Commission should recognise that the split cost of capital approach has significant problems. The most egregious of these is the distortions to future investment incentives the approach would create. The problem is summarised by the Commission's adviser, Dr Lally:[94]

> Such a course of action will damage the investment incentives of firms that are contemplating investment in areas that are currently unregulated, but which may be subject to regulation at some future point.

In view of this obvious problem, and the fact that this approach has gained no traction in jurisdictions such as the UK or Australia, despite having been proposed repeatedly, the Commission should not give significant space to this issue as part of the IM review. We do not consider extensive work is required to conclude a two-tier approach should not be adopted.

---

93 Frontier Economics, Evidence in support of setting allowed rates of return above the midpoint of the WACC range, March 2014, Section 6.

94 Cited in the High Court judgment, para [1445].

# References

Acker, D., and N. W. Duck, 2007. "Reference-day risk and the use of monthly returns data," *Journal of Accounting, Auditing and Finance,* 22, 527–557.

Alexander, I. C. Mayer, and H. Weeds, 1996. "Regulatory structure and risk: An international comparison," *Policy Research Working Paper 1689,* World Bank, December.

Allen Consulting Group, 2008. *Beta for regulated electricity transmission and distribution – Report for Energy Networks Association, Grid Australia and APIA,* September,.

Amihud, Y., 2002. "Illiquidity and stock returns: Cross-section and time-series effects," *Journal of Financial Markets,* 5, 31–56.

Australian Energy Markets Commission, *Summary of issues raised in submissions in response to Directions Paper.*

Australian Energy Regulator, *Rate of return guideline,* Explanatory statement, December 2013.

Australian Energy Regulator, 2015. *Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20,* Final decision, Attachment 3 – Rate of Return.

Black, F., 1972. "Capital market equilibrium with restricted borrowing," *Journal of Business,* 45, 444–455.

Black, F., M.C. Jensen, and M. Scholes, 1972. "The Capital Asset Pricing Model: Some empirical tests," in *Studies in the Theory of Capital Markets,* Michael C. Jensen, ed., New York: Praeger, 79–121.

Brailsford, T., C. Gaunt, and M. O'Brien, 2012. "The investment value of the value premium," *Pacific-Basin Finance Journal,* 20, 416–437.

Brealey, R.A., S.C. Myers, and F. Allen, 2011. *Principles of Corporate Finance,* 10th ed., McGraw-Hill Irwin, New York, NY, USA.

Chan, K.C, and N.F. Chen, 1991. "Structural and return characteristics of small and large firms," *Journal of Finance,* 46, 1467–1484.

Commerce Commission, 2010. *Input methodologies (Electricity distribution and gas pipeline services),* Reasons paper, December.

Commerce Commission, 2015. Transpower Input Methodologies Determination, February.

Commerce Commission, 2015. *Input methodologies review: Invitation to contribute to problem definition*, June.

Cooper, I, 2009. "On tests of the conditional relationship between beta and returns," *Applied Financial Economics,* 19, 427–432.

Da, Z., R. Guo, and R. Jagannathan, 2012. "CAPM for estimating the cost of equity capital: Interpreting the empirical evidence," *Journal of Financial Economics,* 103, 204–220.

Da, Z., and C. Warachka, 2009. "Cashflow risk, systematic earnings revisions, and the cross-section of stock returns," *Journal of Financial Economics,* 94, 448–468.

Dimitrov, V., and S. Govindaraj, 2007. "Reference-day risk: Observations and extensions," *Journal of Accounting, Auditing and Finance,* 22, 559–572.

Economic Regulation Authority, 2015. *Final decision on proposed revisions to the Access Arrangement for the Mid-West and South-West Gas Distribution Systems,* Submitted by ATCO Gas Australia Pty Ltd, June.

ESC, *Melbourne Water 2016 Price Review*, Guidance Paper, April 2015.

ESCOSA, *SA Water Regulatory Rate of Return 2016 – 2020: Final Report to the Treasurer*, March 2015.

Fama, E.F., and K.R. French, 1992. "The cross-section of expected returns," *Journal of Finance,* 47, 427–465.

Fama, E.F., and K.R. French, 1993. "Common risk factors in the returns on stocks and bonds," *Journal of Financial Economics,* 33, 3–56.

Fama, E.F, and K.R. French, 1995. "Size and book-to-market factors in earnings and returns," *Journal of Finance,* 50, 131–155.

Fama, E.F., and K.R. French, 1996. "Multi-factor explanations of asset pricing anomalies," *Journal of Finance,* 51, 55–84.

Fama, E.F., and KR., French, 1998. "Value versus growth: The international evidence," *Journal of Finance,* 53, 1975–1999.

Fama, E.F., and K.R. French, 2004. "The Capital Asset Pricing Model: Theory and Evidence," *Journal of Economic Perspectives,* 18, 25–46.

Fama, E.F., and J.D. MacBeth, 1973. "Risk, return, and equilibrium: Empirical tests," *Journal of Political Economy,* 81, 607–636.

Friend, I., and M. Blume, 1970. "Measurement of portfolio performance under uncertainty," *American Economic Review,* 60, 561–75.

Independent Pricing and Regulatory Tribunal, 2013. *Review of WACC Methodology Research*, Final Report, December.

Independent Pricing and Regulatory Tribunal, 2015. *WACC Biannual Update,* February.

Industry Panel, 2015. *Review of the Independent Competition and Regulatory Commission's 2013 Price Direction for Regulated Water and Sewerage Services in the ACT,* Final report, April.

# References

Lally, M., 2002. "Betas and market leverage," *Accounting Research Journal,* 15, 91–97.

Lewellen, J., S. Nagel, and J. Shanken, 2010. "A skeptical appraisal of asset pricing tests," *Journal of Financial Economics,* 96, 175–194.

Levy, M., and R. Roll, 2010. "The market portfolio may be mean variance efficient after all," *Review of Financial Studies,* 23, 6, 2464–2491.

Lintner, J., 1965. "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets," *Review of Economics and Statistics,* 47, 13–37.

Merton, R.C., 1973. "An intertemporal capital asset pricing model," *Econometrica,* 41, 867–887.

Merton, R.C., 1974. "On the pricing of corporate debt: The risk structure of interest rates," *Journal of Finance,* 29, 449–470.

Michou, M., S. Mouselli and A. Stark, 2014. "On the differences in measuring SMB and HML in the UK – Do they matter?" *British Accounting Review,* 30, 1–14.

Mossin, J., 1966. "Equilibrium in a capital asset market," *Econometrica,* 34, 768–783.

Pettengill, G.N., S. Sundaram, and I. Mathur, 1995. "The conditional relation between beta and returns," *Journal of Financial and Quantitative Analysis,* 30, 101–116.

Petkova, R. and L. Zhang, 2005. "Is value riskier than growth," *Journal of Financial Economics,* 78, 187–202.

Queensland Competition Authority, 2014. *Aurizon Network 2014 Draft Access Undertaking – Maximum Allowable Revenue,* Draft decision, September.

Savor, P., and M. Wilson, 2014. "Asset pricing: A tale of two days," *Journal of Financial Economics,* 113, 171–201.

SFG Consulting, 2014 Aurizon, *Systematic risk of Aurizon Network,* Response to reports and submissions to the Queensland Competition Authority, January.

SFG Consulting, 2014 Black. *Cost of equity in the Black Capital Asset Pricing Model,* Report for Jemena Gas Networks, ActewAGL, Networks NSW, Transend, Ergon and SA Power Networks, May.

SFG Consulting, FF. *The Fama-French model,* Report for Jemena Gas Networks, ActewAGL, Ergon, Transend, TransGrid, and SA PowerNetworks, May,

SFG Consulting, 2014 Risk. *Regression-based estimates of risk parameters for the benchmark firm,* June.

SFG Consulting, 2015. *Using the Fama-French model to estimate the required return on equity*, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausgrid, Ausnet Services, Australian Gas Networks, CitiPower, Endeavour Energy, Energex, Ergon, Essential Energy, Powercor, SA Power Networks and United Energy, February.

Sharpe, W.F., 1964. "Capital asset prices: A theory of market equilibrium under conditions of risk," *Journal of Finance,* 19, 425–442.

Vassalou, M., 2003. "News related to future GDP growth as a risk factor in equity returns," *Journal of Financial Economics,* 68, 47–73.

Vassalou, M., and Y. Xing, 2004. "Default risk in equity returns," *Journal of Finance,* 59, 831–868.

Zhang, L., 2005. "The value premium," *Journal of Finance,* 60, 67–103.

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