

Recommendations to the New Zealand Commerce Commission on an Appropriate Cost of Capital Methodology¹

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ISBN 978-1-869452-82-7

¹ The views expressed in this report are strictly those of the authors and do not necessarily represent the views of any organisation. The authors thank Commission staff for help in recording and assembling the authors' arguments and opinions.

Contents

Authors.....	3
Overview.....	4
General Principles.....	5
1 Regulatory Consistency	5
2 Choosing methods and adjustments.....	5
3 The NPV=0 principle.....	6
Specific Issues.....	7
4 The use of other models alongside the CAPM	7
5 The appropriate form of the CAPM.....	9
6 The use of two different risk-free rates in the CAPM	12
7 Selection of the risk-free rate in the CAPM.....	13
8 Bond durations, spot rates and yields to maturity.....	17
9 Risk-free rate proxies.....	18
10 Estimation of the MRP.....	21
11 Debt betas.....	23
12 Estimation of asset betas	24
13 Adjustments to beta for mean reversion	26
14 Estimating betas for multi-divisional firms	27
15 Leverage.....	28
16 Estimation of the cost of debt	31
17 Taxation	32
18 Modeling estimation errors.....	33
19 Confidence intervals around point estimates	34
20 Use of Monte Carlo simulation for estimating WACC	35
21 Choosing an overall WACC value.....	36
22 Treatment of asymmetric risks.....	37
23 Type II risk and timing options.....	39
24 Other real options.....	41
25 Costs of financial distress	42
26 Resource constraints	43
27 Overall cost of capital sanity check	44
References.....	46

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Overview

We have been engaged by the New Zealand Commerce Commission (the Commission) to review its current methodology for estimating the cost of capital for regulatory purposes, as set out in *Draft Guidelines: The Commerce Commission's Approach to Estimating the Cost of Capital* (the Draft Guidelines). We were asked to review public submissions on the Draft Guidelines and to provide recommendations on an appropriate methodology going forward.²

The topic of cost of capital estimation is vast and evolving. The recommendations contained in this report are therefore by no means exhaustive, nor do they necessarily cover every issue that might arise before the Commission. Instead, our recommendations focus on the areas we see as being of key importance to the Commission at the present time. Our report begins with general principles for estimating the cost of capital and then moves on to more detailed, specific issues.

There were many issues on which it was possible for us to reach a convergence of views. On other issues, we have each expressed differing perspectives and recommendations. This highlights the inevitable judgment required in the process of cost of capital estimation.

In this report, we have endeavoured, to the extent possible, to draw out all areas of agreement and disagreement, and to set out the reasons why. The Commission must now exercise its own judgment in forming a final view.

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18 December, 2008

² The Draft Guidelines and all public submissions are available at:
<http://www.comcom.govt.nz/Publications/draftguidelines.aspx>

General Principles

1 Regulatory Consistency

1. Professor Franks suggests that as long as regulated firms' investments outlive the regulatory period, regulatory consistency is important. There are two aspects to regulatory consistency. First, the methodology or the basis of parameter estimation should not unexpectedly be changed. Second, great care should be taken when making large revisions to the real cost of capital.
2. If estimates of the cost of capital must change significantly, then some consideration should be given to introducing changes gradually, over more than one review period, where assets have long lives. The reasoning is that profitability of new investment is estimated over the lifetime of the investment and not over the single regulatory period. Alternatively, the Commission might apply different allowed rates of return for new investments and existing investments (split costs of capital).

<p>Recommendation 1 Professor Franks recommends that the Commission strive for regulatory consistency: (a) Methods for parameter estimation should not be changed unexpectedly and (b) great care should be taken when making large changes to the real cost of capital. If large changes must occur, these could be introduced gradually, or the Commission might apply split costs of capital to new and existing investments.</p>

2 Choosing methods and adjustments

3. The Panel agrees that the tools the Commission must use in estimating a firm's cost of capital are imperfect and often require compromises and adjustments. For example, there is no one asset pricing model that produces a final and correct answer for a firm's cost of equity. Several methods for estimating market risk premiums (MRPs) exist, each with its own strengths and weaknesses. There are several approaches to estimating betas for multi-product firms. These and other choices and practical issues are discussed later in this report.
4. Professor Franks recommends that the Commission:
 - (a) acknowledge the limitations of the various models and adjustments at the Commission's disposal;
 - (b) carefully explain the pros and cons of each;
 - (c) trace through the numerical implications of adopting each of the various options, or of a combination of approaches if that is feasible, and
 - (d) exercise its judgment in selecting appropriate methods and adjustments.

Recommendation 2 Professor Franks recommends that the Commission not feel compelled to select one methodology or adjustment to the exclusion of all others when estimating components of the cost of capital. Instead, the Commission should carefully describe all alternatives and the implications of choosing each of these, and then using its judgment select one or a combination of methods and adjustments.

3 The NPV=0 principle

5. One of the Commission's regulatory standards is the 'NPV = 0' principle, which states that regulated firms ought to earn a reasonable rate of return (their cost of capital) and recover their investments.³ In other words, regulation should constrain companies from earning excess profits.
6. A number of submitters on the Draft Guidelines (including Maui Development Ltd. and Vector) have argued that, in practice, firms (even those in 'workably competitive markets') do not invest simply when NPV is equal to zero (at least not at the CAPM-derived WACC);⁴ NPV must be positive. It is argued that this is inconsistent with the Commission's NPV = 0 principle.
7. Of course profits fluctuate, even in regulated industries, so profits that are sometimes higher or lower than the cost of capital do not violate the NPV = 0 principle. But the principle should rule out cases where expected profitability or long-run average profitability significantly exceeds the cost of capital.
8. Dr Lally notes that there are a number of potential explanations for firms requiring a positive NPV before investing that do not suggest that the Commission should act in the same way. For example, firms might be concerned about the possibility of cash flows being overestimated by project proponents, and therefore require a positive NPV to counteract this bias. However, the Commission forms its own estimates of cash flows, which should be unbiased. Accordingly, it would be inappropriate for the Commission to adopt a positive-NPV rule.
9. The Panel agrees with the Commission's adherence to the NPV = 0 principle. As long as the allowed rate of return covers the cost of capital, firms will earn a reasonable return on their investments.
10. The Panel also points out that in recognition of likely estimation errors and the social costs of setting allowed returns too low, the Commission normally chooses a WACC value above the midpoint in the estimated range. The Panel agrees with this practice.
11. The Panel considers that regulated companies should be allowed to keep any profits gained over the regulatory period through incremental efficiency savings. One mechanism to strengthen incentives under such a scheme is to lengthen the regulatory period, which allows profits gained over a longer period to be retained. Professor

³ NPV is the net present value of investment. This principle is discussed further in the context of choosing an appropriate maturity for the risk-free rate in Section 7 below.

⁴ CAPM refers to the capital asset pricing model, WACC to the weighted average cost of capital. Both are discussed below.

Franks prefers this approach to simply raising the cost of capital, as advocated by some submitters.

Recommendation 3 The Panel agrees with the Commission's approach of allowing regulated firms to earn their cost of capital and recover the initial cost of investment, as long as the Commission ensures that the allowed regulatory return adequately covers the cost of capital.

Recommendation 4 The Panel agrees that incentive schemes that allow firms to keep profits generated over the regulatory period through efficiency savings are desirable.

Recommendation 5 One mechanism to strengthen incentives is to lengthen the regulatory period. Professor Franks prefers such a mechanism to simply raising the allowed rate of return.

Specific Issues

4 The use of other models alongside the CAPM

12. At present, the Commission exclusively uses a version of the Capital Asset Pricing Model (CAPM) to estimate firms' cost of equity, a major input into the estimation of the WACC.
13. Professors Myers and Franks point out that, although the CAPM is very useful, it does suffer from several limitations. Fama and French (1996, 2004) and overseas regulators (e.g. OFWAT in the UK) have shown that the CAPM does not always produce robust, stable estimates. The CAPM does not explain differences in returns averaged over stocks and long periods of time. The CAPM can also give noisy or unstable estimates for given stocks at a particular point in time.
14. Professors Myers and Franks recommend the Commission employ other methods as cross-checks on CAPM estimates, provided that adequate data are available. Cross-checks should be done unless there are good reasons to the contrary.⁵
15. The most natural models to use as cross-checks are the Discounted Cash Flow (DCF) model for equity valuation⁶ and Arbitrage Pricing Theory (APT) models, the most common of which is the Fama-French three-factor model.⁷ Good academic research does not rely exclusively on single-factor models such as the CAPM.

⁵ Professors Franks and Myers believe that the use of cross-checks is a better response to possible estimation errors than adopting a default equity beta of one, as suggested by several submitters (Professors Bowman and Officer, Vector and CRA).

⁶ The *DCF model* for equity valuation, also known as the Dividend Discount Model (DDM), solves for the required rate of return that equates the current value of a stock to the present value of its future stream of dividends.

⁷ See, for instance, Brealey, Myers and Allen (2008), Chapter 9, pp. 223-227.

16. Dr Lally agrees that it is desirable to consider the results from a range of approaches, but has reservations about both the DCF and the Fama-French models. The DCF model does not formally reflect the risk-free rate (and this precludes choosing an appropriate term for the risk-free rate), is exposed to difficulties in estimating the expected growth rate in dividends, and will tend to produce a biased estimate of the cost of equity if the firm alters its payout rate over time. The Fama-French model is purely empirical (there is no rigorous theory that gives rise to the size and book-to-market effects in the model). Furthermore, even if size and book-to-market do affect expected returns, the correct ex-ante signs on the risk premiums for these two factors are not apparent, thereby raising the risk of spurious empirical results. Finally, if these alternative methods are used, they would warrant less weight than the CAPM, thereby raising the question of what weights ought to be applied to these models.
17. Professors Myers and Franks consider that the DCF and Fama-French methods should not be the primary evidence in estimating firms' cost of equity, but can be useful nonetheless. They recommend that the weighting applied to each method not be fixed, but rather be adjusted on a case-by-case basis. This is because the performance of these models can vary across industries and firms. For instance, the DCF model works best in stable, mature industries where dividends and earnings are growing roughly in balance. When these conditions are not met, it may be possible to fit a two-stage or three-stage DCF model that performs better. If, however, these approaches also fail to give sensible estimates, then the DCF approach should be abandoned as a cross-check. The Fama-French model sometimes gives unstable or implausible cost of capital estimates, although the model works better for portfolios of securities than for individual companies. This model could be useful when industry costs of capital are estimated.
18. Dr Lally argues that applying flexible weights to these models may be viewed by affected entities as introducing too much subjectivity or arbitrariness to the process.
19. Professors Myers and Franks recognise that all these models are imperfect tools, and therefore, judgment is unavoidable in their application. They argue that the Commission should explicitly set out the limitations of each approach, and the reasons why varying weights on a case-by-case basis is warranted, and having reviewed all the evidence, exercise its judgment.
20. Finally, the Panel recommends that the Commission identify and review new estimation methods periodically, with review periods no longer than five years apart.

Recommendation 6 Professors Myers and Franks are in favour of employing the DCF and Fama-French three-factor models as cross-checks on CAPM estimates of the cost of equity, provided that necessary data are available and that the models' assumptions are reasonably satisfied. The relative weights attached to each of these methods should be determined on a case-by-case basis. Dr Lally expresses some reservations about these alternative models, but nonetheless agrees in principle that they should not be entirely dismissed in the estimation process.

Recommendation 7 The Panel recommends that the Commission identify and review new estimation methods periodically.

5 The appropriate form of the CAPM

21. The Commission presently applies the simplified form of the Brennan-Lally CAPM.⁸ This version of the CAPM explicitly takes into account the fact that both cash dividends and capital gains are taxed less onerously than interest in New Zealand (the former through the dividend imputation system). In addition, like the classical form of the CAPM, it assumes that national capital markets are perfectly segmented.⁹
22. Professor Myers recommends the Commission use the classical CAPM rather than the simplified form of the Brennan-Lally CAPM, because:
 - (a) Any deviation from the simplified Brennan-Lally model's underlying assumptions would lead to underestimates of the cost of equity for low-beta firms.
 - (b) New Zealand is open to foreign investment, and portfolio investments by foreigners, who do not benefit from dividend imputation, but must influence local equity prices.
 - (c) the closed-economy assumption of the simplified Brennan-Lally model would understate the cost of capital for low-risk firms in New Zealand, and overstate it for high-risk firms.
 - (d) Empirical evidence shows that average returns for low-beta firms are higher than predicted by the classical CAPM. This bias is amplified in the simplified Brennan-Lally model.
23. Professor Myers argues that the assumptions underlying the simplified Brennan-Lally CAPM are likely to be too extreme. Submitters have pointed out that not all investors in New Zealand enjoy imputation credits, and the New Zealand economy is not closed.
24. Professor Myers argues that, even with partially integrated economies, marginal rates of return in New Zealand should converge towards international marginal rates of return, at least in industries open to foreign investment. Large international companies typically estimate their cost of capital using the classical CAPM and market risk premiums (MRPs) demanded by investors in the largest markets, including the US and the UK. Such firms would invest in New Zealand up to the point where their marginal return on capital equals their WACC derived using the classical CAPM. (The specific tax regime in New Zealand should not matter to

⁸ The simplified Brennan-Lally version of the CAPM is $k_e = R_f(1-T) + [k_m - R_f(1-T)]\beta$, where R_f is the risk-free rate, T is the average marginal tax rate on ordinary income across all equity investors in the New Zealand economy, k_m is the expected return on the market portfolio, and β is the firm's equity beta. See Cliffe and Marsden (1992) and Lally (1992).

⁹ The classical CAPM was developed by Sharpe (1964), Lintner (1965) and Mossin (1966).

international investors.) Such behaviour by large international investors and corporations provides a valuable insight into what marginal rates of return should be in New Zealand, given its status as a small open economy. So, using the same estimation approach as these firms – the classical CAPM – is appropriate for regulatory purposes.

25. Dr Lally does not favour choosing a CAPM on the basis of the model invoked by large international firms investing in New Zealand, as suggested by Professor Myers. Large international firms investing in New Zealand are drawn from a range of countries, and the choice of foreign country would affect the resulting parameters in the CAPM if Professor Myers's approach were adopted. For example, if the foreign firms investing in New Zealand are assumed to be American, the MRP would be that for the US and betas of New Zealand assets would be defined against the US market. By contrast, if the foreign firms are assumed to be Australian, then Australian parameters would substitute for American ones.
26. Professor Franks's position is that the central issue to the debate on the appropriate form of the CAPM is the degree of investor home bias.¹⁰ Perfectly integrated capital markets drive one to select an International Capital Asset Pricing Model (ICAPM), whereas perfectly segmented capital markets suggest that a domestic CAPM is appropriate. Professor Franks recommends estimating the cost of equity using the ICAPM (with no exchange rate risk), the Brennan-Lally CAPM, and the classical CAPM, and then using all the information available on the degree of home-bias, selecting the appropriate form of the CAPM.
27. The spread in estimates derived from the various approaches would provide an indication of the 'error' associated with choosing the different approaches. It would be wise to know the size of differences across the models before making a model selection.
28. In respect of these three versions of the CAPM, Dr Lally considers that the taxation assumptions of the simplified Brennan-Lally model accord much more closely with the taxation environment in New Zealand than those underlying the classical form of the CAPM, and the former is therefore preferable. In comparing the simplified Brennan-Lally model with the ICAPM, the former assumes that capital markets are completely segregated and the latter that they are completely integrated. Neither assumption is clearly better than the other. However, parameter estimates for the ICAPM are much less well developed.¹¹ Furthermore, the ICAPM tends to generate lower estimates for the cost of equity and conservatism points to favouring the model

¹⁰ *Home bias* is the tendency for investors to invest in a large proportion of domestic assets, despite the benefits of international diversification. Transaction costs and international legal restrictions have been cited as possible explanations for this phenomenon.

¹¹ Betas are usually defined against country rather than world indexes and ICAPMs require the latter. Also, Dr Lally argues that as markets become more integrated, investors' portfolios become more diversified, and assuming their degree of risk aversion remains unchanged, the international MRP will in general be less than MRPs for individual markets prior to integration (Stulz, 1995, p 19). Thus an estimate of the International MRP based upon long-term historical average returns would tend to overstate the current and future values of this MRP and therefore may not be desirable.

generating the higher estimate. This points to adoption of the simplified Brennan-Lally model.

29. Alternatively, if one considered the results from all three models, Dr Lally considers that the classical CAPM tends to produce the highest cost of capital estimates, the simplified Brennan-Lally model estimates that are somewhat lower, and the lowest estimates of all tend to come from the ICAPM.^{12,13} Taking a ‘compromise’ between the alternative models also points towards selecting the simplified Brennan-Lally version.
30. Dr Lally also notes that many submitters who expressed a preference for a particular model supported the use of the simplified Brennan-Lally CAPM or slight variants on it.¹⁴ In addition, many of them appear to use the model or slight variants on it themselves (including Goldman Sachs JBWere, PricewaterhouseCoopers (PWC), Transpower, and Vodafone). Dr Lally considers that there are advantages to any regulator in using a model that is generally employed by regulated firms.
31. Professor Franks notes that in the late 1980s and early 1990s the UK had a partial imputation system, and most parties used a Brennan-Lally-type model.
32. Professor Myers agrees that the ICAPM can not be strictly correct, because capital markets are not perfectly integrated. Also, the ICAPM is not often used in practice. But he does not agree that the ICAPM will necessarily yield lower estimates than the simplified Brennan-Lally model for firms in New Zealand.

Recommendation 8 Dr Lally recommends the Commission retain the simplified Brennan-Lally version of the CAPM.

Recommendation 9 Professor Myers recommends the Commission use the classical CAPM instead.

Recommendation 10 Professor Franks recommends estimating the cost of capital under each of these models, and the ICAPM, and using all the available evidence on the degree of home bias to select the appropriate form of the CAPM.

¹² The cost of equity produced by the simplified Brennan-Lally model will diverge from that produced by the classical CAPM by $R_f [T(1 - \beta)]$.

¹³ Moving from a domestic to an international version of the CAPM would tend to significantly reduce the beta estimate of a typical New Zealand firm (Bryant and Eleswarapu, 1997, Table 5). Furthermore, as noted in footnote 11, as markets become more integrated, investors’ portfolios become more diversified, and assuming their degree of risk aversion remains unchanged, the international market risk premium would in general be less than that of individual markets prior to integration (Stulz, 1995, p 19). These two effects suggest that use of an ICAPM (as in Solnik, 1974) would produce appreciably lower cost of equity estimates than a domestic version of the CAPM particularly in the case of New Zealand.

¹⁴ Of the parties making submissions and expressing a preference for a particular model, six favoured the simplified Brennan-Lally model or a slight variant on it whilst another five favoured an alternative model (CRA favoured the classical CAPM; Professor Officer and Orion preferred the Officer (1994) model employed by Australian regulators; Professor Bowman favoured the classical CAPM or the Officer model; and Marsden Jacob Associates recommended the ICAPM). In addition, two submitters (ABN AMRO and Brook Asset Management) raised concerns over the underlying assumptions of the simplified Brennan-Lally model, but did not propose any alternatives.

6 The use of two different risk-free rates in the CAPM

33. The Commission presently assumes that the CAPM is a medium-to-long-term model. (It is assumed that investors' planning horizon is roughly five to ten years.) In line with this assumption the Commission estimates the MRP term in the CAPM using a long-term risk-free rate. However, in order to satisfy the $NPV = 0$ principle, the Commission matches the maturity of the risk-free rate in the intercept term of the CAPM to the length of the regulatory period, usually one to five years. As a result, in most instances the Commission employs two different risk-free rates in the same CAPM equation.
34. Professors Myers argues that, contrary to the Commission's interpretation, the CAPM is in fact a one-period model; the length of the period is always interpreted as relatively short, at most one year. (The classic tests of the CAPM all used annual rates of return.) If investors are rational and investing according to the CAPM, they will rebalance their portfolios frequently; the investment horizon should be interpreted as the interval in time between two points of rebalancing. Furthermore, CAPM equity betas are estimated using high-frequency returns data.
35. Dr Lally considers that the investment horizon should be defined as the average interval (across investors) between portfolio reassessments, and an upper bound on this is the average holding period for assets (equities). Froot, Perold and Stein (1992, Table 1) report variation in holding periods across investor classes in the US ranging from one to seven years, and this suggests an average holding period of several years. Thus, the investment horizon could be as low as a few months but it could also be several years. Furthermore, general practice in New Zealand and Australia has been to define this horizon in excess of one year.
36. Professors Myers and Franks agree that in principle the Commission should only use one risk-free rate in the CAPM equation. That is, the MRP should be estimated relative to the same interest rate used in the intercept term of the CAPM formula.
37. Dr Lally considers that a literal application of the CAPM demands the use of a single risk-free rate within the intercept term and the MRP, that this rate should be for a term equal to the average interval (across investors) between portfolio reassessments, and that this term could be several years. However, Dr Lally also considers that satisfying the $NPV = 0$ principle requires the risk-free rate within the intercept term of the CAPM to match the regulatory period, and this may lead to two different risk-free rates within the CAPM. Dr Lally considers that it may sometimes be desirable to deviate from the literal interpretation of a model, where real-world situations are more complex than provided for in that model or on account of data limitations. For example, even if one interprets the CAPM as applying to a one year period, and therefore betas would be defined over such a period, data limitations lead to the use of monthly rather than annual returns in estimating betas and the choice of period can induce estimation biases (Levhari and Levy, 1977; Handa et al, 1989).
38. Professor Myers advises that the Commission's conclusion in the Draft Guidelines that it is not possible to apply a theoretically pure version of the CAPM, and the

assumption in para 94 of the Draft Guidelines that ‘the MRP is invariant across different time horizons,’ is incorrect and should be carefully rethought. Professor Franks also takes exception to the assumption made in para 94. In his view this assumption is uncomfortable, too sweeping, and contrary to published evidence (Welch, 2000, Dimson, Marsh and Staunton, 2002) that the MRP does vary according to the length of the assumed time horizon.¹⁵

Recommendation 11 Dr Lally recommends that the Commission define the MRP relative to the average interval (across investors) between portfolio reassessments and define the term of the first risk-free rate within the CAPM to match the regulatory period, even if this leads to the use of two different risk-free rates within the CAPM.

Recommendation 12 Professors Myers and Franks recommend that the Commission employ only one risk-free rate in the CAPM.

7 Selection of the risk-free rate in the CAPM

39. The Commission presently matches the maturity of the first risk-free rate in the CAPM equation (see footnote 8) to the length of the regulatory period. The rationale for doing so is to satisfy the NPV = 0 principle, discussed earlier in Section 3.
40. In selecting the appropriate risk-free rate for the CAPM, Professor Myers identifies two separate issues. First, how should the Commission obtain a long-term cost of capital from the CAPM, which is a short-term model? Second, how should the Commission define ‘long-term?’ Should it match its cost of capital to the term of the regulatory cycle, which varies, or should it standardize on a term of, say, five years?
41. Assume that a cost of capital or discount rate is needed for a term of L years, longer than the horizon of CAPM investors. Assume this horizon is one year. Taking L as given, there are two ways to get an L-period cost of capital.
 - (a) Use the L-period interest rate as the intercept in the CAPM. Define the MRP as the difference between expected returns on the stock market and expected returns on L-period bonds. The historical measure of this MRP would average annual returns on the market vs. L-period bonds.¹⁶

¹⁵ The statement that ‘the MRP is invariant across different time horizons’ is ambiguous and can be misinterpreted. The MRP can be estimated as a spread over short-term or long-term risk-free returns, for example vs. short-term Treasury bills or long-term Treasury bonds. Historical average spreads over bills have been higher than spreads over bonds. Thus the MRP has not been ‘invariant’ across the horizons of investors in safe securities. However, MRPs estimated relative to bills or to bonds, though not the same, could each be stable over time.

¹⁶ The procedure for calculating the historical average is as follows. For each past year in the historical sample, record the difference between the return on the market and the return on a portfolio of L-period bonds in that year. Generate a series of annual risk premiums, then average. As discussed in Section 10, the Commission may also wish to consider forward-looking estimates of the MRP, here defined as a spread over expected L-period bond returns.

- (b) Estimate the MRP as the difference between returns on the stock market and returns on one-year bonds.¹⁷ Then use an L-period forecast of average future one-period interest rates as the intercept in the CAPM.
42. In each case, there is only one risk-free rate in the CAPM equation, an L-period rate in (a) and a one-period rate in (b). The MRP can change, because it is estimated vs. L-year interest rates in (a) and one-year rates in (b). The MRP in (b) is independent of L. However, (b) requires an L-period forecast of one year rates for the CAPM intercept.
43. One way to forecast average future one-period interest rates over the next L years is to take the current L-period interest rate and subtract an L-period maturity risk premium which reflects the risks borne by investors in long-term bonds. Historically long term bonds have earned a significant risk premium over short term bills. This maturity risk premium may reflect inflation uncertainty and a preference for more liquid short-term investments.
44. Professor Myers notes that approach (a) is acceptable and is used in many regulatory settings. This approach generates a flatter security-market line, which can compensate for the fact that average returns for low-beta firms tend to be higher than predicted by the CAPM.¹⁸
45. However, Professor Myers believes that approach (b) is conceptually better, because the CAPM is a short-term model. This approach uses forecasts of short rates over a longer term. Forecasts of betas and the MRP are used in the CAPM, so it is consistent to also use forecasted one-year rates as the intercept.
46. The second issue is to choose L. One option is for the Commission to match L to the length of the regulatory period (so $L =$ the cycle length), which can vary. Then use one of the adjustments (a) or (b), in each case setting $L =$ the cycle length. This approach would avoid any violation of the $NPV = 0$ principle from a difference between the term of the CAPM interest rate and the length of the regulatory cycle.
47. However, Professor Myers recommends an alternative approach of standardizing on $L = 5$. His reasons are the following:
- (a) The duration of regulated assets generally exceeds the regulatory period. Applying $L = 5$ is a compromise.
 - (b) It is not obvious that the size of the error arising from violation of the $NPV = 0$ principle when $L = 5$ is significant.
 - (c) Traditional rate-of-return regulation does not adjust allowed returns (much less allowed profits) in lock-step with changes in interest rates at the end of each regulatory cycle.¹⁹

¹⁷ The historical measure would average returns on the market vs. one-period interest rates at the start of each year. Forward-looking MRPs could also be estimated, in this case as a spread over one-period interest rates.

¹⁸ The *security market line* is the linear CAPM relationship between expected return and beta. A stock's beta measures its market risk.

¹⁹ Here Professor Myers is relying on US experience. US regulators may update inputs in each regulatory proceeding, but they do not always update the allowed rate of return proportionally. For example,

- (d) The Commission uses WACC in many different ways. In most cases it will not literally fix and then reset prices at predefined intervals.
48. In most cases the length of the regulatory cycle (or a standardized term of $L = 5$) will be much less than the life of the regulated firm's assets. Professor Myers argues that if regulated firms with long-lived assets see material rate risk from the Commission applying a short- or medium-term cost of capital, that risk could be offset in the interest-rate swap market.
 49. Professor Franks agrees with Professor Myers that method (b) provides the best solution. However, a maturity risk premium based upon a long historical time series may not capture the risk premium built into current long-term interest rates. In recent years interest rates and inflation have been relatively low and therefore any risk premium due to inflation may be lower than historical averages suggest. Using 40 years of US data, Buraschi and Jiltsov (2005) find that the inflation risk premium is the dominant factor explaining the time varying nature of the maturity risk premium. This premium averages 70 basis points over the 40 years, but it varies from 20 to 140 basis points over the entire business cycle.²⁰
 50. One UK regulator (OFCOM) has in the past used an approach similar to method (b) suggested by Professor Myers, but instead of deducting an average historical maturity risk premium, it has deducted an estimated 'inflation risk premium' using the approach followed by Buraschi and Jiltsov. However, deductions have not been made in recent years because OFCOM believed the inflation risk premium to be close to zero. Drawing on the UK experience, Professor Franks recommends that the risk premium adjustment in approach (b) should reflect factors built into current levels of interest rates and inflation.
 51. Professors Franks and Myers agree that, even when the term structure of interest rates is flat, there can be a positive maturity risk premium in the term structure. For example, expectations about falling future inflation can cause the term structure of nominal rates to appear flat when the term structure of real interest rates is upward-sloping.
 52. Professor Franks generally agrees with Professor Myers's recommended approach (b). However, he suggests that if regulatory cycles in New Zealand are typically three years, the Commission could standardize on $L = 3$ rather than $L = 5$.
 53. Dr Lally considers that, under the approach (b) favoured by Professor Myers, the implied cost of equity on a firm delivering a single risk-free cash flow in five years would be the average of the forecast annual risk-free rates over the next five years. This would diverge from the spot rate on a five year risk-free bond, due to maturity risk premiums on bonds. However, by definition of the risk-free rate, an asset delivering a single risk-free cash flow in five years must be valued using the five year

regulators adjust allowed rates of return gradually when interest rates change, in effect using a moving average of interest rates. Thus a plot of allowed rates of return over time is usually smoother than a plot of interest rates.

²⁰ For a study of the UK inflation risk premium, see Evans (1998).

rate. Thus, approach (b) would yield the wrong answer in this case and must therefore be conceptually flawed.

54. Although the Commission has never scrutinized a risk-free firm, Dr Lally considers the scenario examined still reveals that there is a conceptual difficulty in process (b). The problem arises from the fact that approach (b) involves application of the CAPM successively to a number of periods. Such a practice implies that investors ignore the possibility of unpredictable future changes in interest rates. This in turn implies that maturity risk premiums on bonds do not exist. As a result, there would be no difference between the current five year spot rate and the forecast of shorter term rates over that period.
55. Professors Myers disagrees with Dr Lally's arguments at para 53 and para 54. He argues that, in a CAPM world, investors in an L-period asset can be thought of as making a *series* of short-term investments (see Section 6), rolled over L times, with expected returns for each round of investments based on the then-prevailing short rate. That is, portfolio rebalancing occurs frequently. As beta declines to zero, the expected CAPM return in each period converges to the short rate in that period. The return earned, going forward in time, depends on the path of short rates. Consistent discounting therefore requires a forecast of expected future short rates. Therefore, the suggestion of a conceptual flaw in approach (b) is incorrect.²¹
56. Dr Lally considers that a literal application of the CAPM requires the use of a single risk-free rate in both the intercept term and the MRP, that this rate should correspond to the average interval (across investors) between portfolio reassessments, and that this term could be as low as a few months or as high as several years. However, so long as the Commission resets output prices exactly in accordance with prevailing interest rates for the regulatory cycle and this regulatory process prevails over the residual life of the asset, then the NPV = 0 principle implies that the maturity of the risk-free rate within the intercept term in the CAPM should match the regulatory cycle.
57. The size of the error from not matching the maturity of the risk-free rate to the length of the regulatory period depends not only on the length of the regulatory cycle (the greater the mismatch, the greater the error), but also on the slope of the term structure of interest rates. Presently, the term structure of interest rates from one to five years in New Zealand is sloping downwards quite sharply, and this has occurred repeatedly in the last several years.
58. Dr Lally acknowledges that under his recommended approach, two different risk-free rates may arise in the CAPM formula (one in the intercept term in the model and the other within the MRP). Dr Lally argues that the result is a pragmatic modification of the CAPM to preserve the NPV = 0 principle.

²¹ A fixed future cash flow at date t should of course be discounted at the spot rate for date t. But that spot rate is not generally the correct discount rate for the payoff from a series of t one-period investments. When beta is zero, the CAPM implies the latter investment strategy.

Recommendation 13 Dr Lally recommends the Commission retain its current practice of setting the intercept term in the CAPM equal to the current risk-free rate whose maturity matches the length of the regulatory cycle. The MRP should be defined relative to the average interval (across investors) between portfolio reassessments, and this could be as low as a few months or as high as several years.

Recommendation 14 Professor Myers recommends using a L-year forecast of the one-year risk-free rate as the intercept term of the CAPM, with the MRP defined as a spread over one-year interest rates. Professor Myers recommends standardizing $L = 5$ years. If standardization is rejected, L should match the length of the regulatory cycle. If the yield on an L-year Treasury bond is used as the intercept, the MRP should be defined as a spread over L-year interest rates.

Recommendation 15 Professor Franks agrees with this recommendation, but suggests that any adjustment to the L-period forecast for the maturity risk premium should reflect current levels of interest rates and inflation and not historical averages. Further, the Commission could standardize $L = 3$ if regulatory cycles in New Zealand are typically three years.

8 Bond durations, spot rates and yields to maturity

59. In line with the suggestion of one submitter (Professor Roger Bowden), Dr Lally accepts that the risk-free rate selected by the Commission should have a duration, rather than a term, equal to that of the regulatory cash flows.²² However, Dr Lally argues that the matching of terms rather than durations provides a very close approximation.
60. The Commission currently uses yields to maturity when applying the CAPM formula.²³
61. Professor Franks argues that, if the term structure is seriously upward or downward sloping, spot interest rates could be used in place of yields to maturity.²⁴
62. Yields to maturity are an average of spot rates and if used for valuation purposes will misprice the asset. The size of the error is likely to be greatest for low-risk enterprises because the NPV of such investments are more sensitive to changes in the risk-free rate than for risky projects, which will have a larger risk premium. Hence,

²² For a flat term structure, *duration* is the weighted average number of years before receipt of an asset's cash flows, where the weights are the discounted values of the cash flows. Duration is shorter than the *term* of a bond, which refers to its time to maturity. For example, a ten-year coupon bond has a term of ten years (because the principal is repaid in year ten), but a duration of less than ten years, because cash flows from coupons are received from years one through ten.

²³ The *yield to maturity* is the discount rate that makes the discounted value of the promised future bond payments (interest and principal repayment) equal to the market price of the bond. The yield to maturity is the internal rate of return on the bond.

²⁴ *Spot interest rates* are the rates for single future payments, for example from stripped or zero-coupon bonds.

the use of spot rates might be particularly appropriate when the Commission is dealing with low-risk assets.

63. Professor Myers agrees that the Commission could employ spot rates rather than yields to maturity, although yields to maturity are generally approximately right.
64. If the Commission employs spot rates, say when setting a price cap, it could use annual spot rates to set the annual allowed cash flows for the firm. If instead a single price cap is desired, the Commission could solve for the allowed annual cash flows that make $NPV = 0$, given the spot discount rates. This would be similar in principle to solving an internal rate of return problem, except that the Commission would be solving for allowed cash flows rather than the discount rate that makes $NPV = 0$.
65. Spot rates could be sourced from the fixed income departments of investment banks, from LIBOR swap rates or from yields on zero-coupon Treasuries.²⁵
66. Professor Franks suggests that, as an approximation, a bond's yield to maturity be employed and spot rates be used as a cross-check. Dr Lally agrees with the use of yields to maturity subject to checking against spot rates.

Recommendation 16 Dr Lally accepts that the risk-free rate should have a duration, rather than a term, equal to that of the regulatory cash flows, but he argues that the effect of using terms rather than durations is slight.

Recommendation 17 The Panel recommends that the Commission employ yields to maturity as an approximation (as it presently does), but use spot rates as a cross-check.

9 Risk-free rate proxies

67. The Commission presently uses government bond rates as a proxy for the risk-free rate. One submission (from Telecom) argues that recent reductions in the supply of government bonds have reduced yields on government bonds, and that this favours the use of swap rates rather than government bond yields as a proxy for the risk-free rate. The submission cites, among other evidence, Blanco et al. (2005) in support of this view.
68. Dr Lally argues that, within the context of the CAPM, there are no requirements relating to the supply of any asset. Thus, a reduction in the supply of an asset would not disqualify it as a good proxy for the risk-free asset. Furthermore, one of the reasons noted by Blanco et al. for their view that government bond rates are a poor proxy for the risk-free rate is 'taxation treatment' (p. 2261). This is presumably a reference to the fact that yields on US government securities are tax exempt at the state level, whereas other bonds are not. If so, this point has no parallel in New Zealand.

²⁵ The approximate shape of the term structure is evident from yield curves. Precise estimates of the term structure of spot rates can encounter technical issues that are best left to fixed-income professionals. In practice it may be best to rely on banks to provide spot rates.

69. Dr Lally considers that a good proxy for the risk-free rate within the context of the CAPM should be free of risk, liquid, free of restrictions upon the purchase of the asset, and the asset should not have characteristics other than its return distribution that attracts or repels investors. Swap rates reflect greater default risk, which argues against their use, although the extent of this is likely to be small. On the other hand, government bonds can be used for collateral purposes, which depresses their yields and therefore argues against their use. On balance, it is not apparent that swap rates are a better proxy for the risk-free rate.
70. Furthermore, even if the swap rate were used as a proxy for the risk-free rate, and therefore raised the intercept term in the CAPM, it would also have to be used in estimating the MRP. With equity betas on regulated firms that are close to 1, the two effects would largely offset even if it were possible to adjust the MRP. In addition, adjustment to the MRP would be difficult if the MRP was estimated using historical data up to 100 years old because the swap market is a recent phenomenon.²⁶ Dr Lally therefore suggests that, in the present regulatory context, the risk-free rate should continue to be proxied by the yield on government bonds.
71. Professor Franks agrees with Dr Lally's concerns about the need for consistency when using swap rates as the risk-free rate in both the intercept and the estimated market equity premium in the calculation of the cost of equity. He believes the issue is important and requires further consideration.²⁷
72. Professor Franks also points out another issue raised by UK regulators in setting the risk-free rate. Some participants in UK capital markets, including the Bank of England, have argued that yields on UK government bonds have been well below historical levels and that those yields are unlikely to be sustained. They have been affected in part by significantly increased demand for government bonds by pension funds. Other independent academic research finds evidence of mean-reversion in government bond rates. Thus, there is some concern that low government bond yields are temporary.²⁸
73. A second concern has been the substantial volatility in the government bond market.²⁹ If intervals between regulatory reviews are reasonably long (say three years or more), and there is significant volatility in government bond yields, regulated companies may find that the cost of finance has risen during the regulated period (over that initially set) and this may undermine investment incentives. Again if companies can lock in the low cost of finance at the beginning of the regulatory period, this issue

²⁶ Blanco et al. were not concerned with estimating a cost of capital using the CAPM.

²⁷ NERA proposes the use of swap rates as the basis for the real risk free rate in their report on the cost of capital for UK water companies. NERA (2008), pp. 19-26.

²⁸ During the recent period of market turbulence there has been a 'flight to quality' (i.e. a flow of funds from riskier to safer investments, which sometimes occurs during times of high market volatility) and yields on government securities have declined significantly. In addition, the spreads on AAA bonds over equivalent government bonds have also widened. There is a concern that these movements are temporary and that current government bond rates may not provide adequate proxies for the risk-free rate in regulatory decisions.

²⁹ During 2006-2007, real yields on UK five-year inflation-protected government bonds have fluctuated between about 0.9% and 2.5%.

becomes unimportant. It is only important if there are significant costs to locking in the low cost of finance.

74. In recent years, UK regulators have responded to these issues by allowing some 'headroom' above current spot government bond yields prevailing at the beginning of the regulatory period. This headroom has frequently been included in both their cost of equity and debt calculations.
75. However, amid concerns that this solution provided something of a 'free lunch' to regulated firms, several UK regulators are considering a second option, which involves *indexing* the risk-free rate to a portfolio of government bonds; this could be accomplished by constructing a portfolio of bonds with a duration matching that of the regulatory cash flows.³⁰ Individual bonds comprising this portfolio may have varying maturities. The cost of equity would be set initially according to current spot rates, and then reset periodically within the regulatory cycle on the basis of the prevailing yield on the bond portfolio.³¹ Other variables such as the MRP and beta would remain fixed over the regulatory period.
76. Another option is for the regulator to consider reopening a price review if spot rates rise sharply during the regulatory period. However, this provides an asymmetric payoff to the regulated firm since the firm would gain if rates fall, and would be compensated by the regulator if rates move up. Hence, Professor Franks prefers the indexation option.
77. Dr Lally does not consider that changes in interest rates within regulatory cycles warrants a regulatory reaction. The NPV = 0 principle is preserved by defining the risk-free rate within the intercept term of the CAPM to match the length of the regulatory cycle. If prices are to be reset more frequently in response to interest rate changes, and therefore the regulatory cycle effectively shortened (with consequent changes to the appropriate risk-free rate within the first term of the CAPM so as to preserve the NPV = 0 principle), consumers will face more volatile prices (which may not be desirable). A possible exception arises in respect of large capital expenditures within a regulatory cycle, whose timing is unpredictable. In this case, the regulator could revise the price cap within the regulatory cycle to reflect changes in the risk free rate from the beginning of the regulatory cycle to the time of the capital expenditures, but only in respect of these capital expenditures and not in respect of existing assets.
78. Professor Myers has informal evidence from fixed-income markets that swap spreads are being used as base interest rates in place of Treasury rates, but he has no confident independent opinion on this subject. Professor Myers doubts that indexation would

³⁰ ORR/OFWAT sponsored a paper on indexation: Indexing the Allowed Rate of Return, by Cambridge Economic Policy Associates, September 2007. This paper discusses the pros and cons of indexation. It also suggests restricting indexation to the regulated firm's debt securities although it did not give a clear exposition for this conclusion.

³¹ The implementation of indexation would necessarily lead to modifications in the maturity of the risk-free rate, made in para 50. However, this would only take place if three conditions were fulfilled: government bond yields were volatile, the regulatory period is longer than three years, and if there are significant costs to firms locking in low cost of finance.

solve a first-order problem, but is willing to keep the issue open for further observation and analysis.

Recommendation 18 Dr Lally recommends that the risk-free rate should continue to be proxied by the yield on government bonds.

Recommendation 19 Professors Franks and Myers recommend that the issue of swap rates as proxies for the risk-free rate is important and requires further consideration.

Recommendation 20 Professor Franks recommends that when there is significant volatility in government bond yields, and the regulatory period exceeds three years, the Commission should consider the feasibility of indexing the risk-free rate component of the cost of capital to a portfolio of government bonds whose duration matches that of the regulatory cash flows.

10 Estimation of the MRP

79. The Commission's current practice when estimating the MRP is to draw on international estimates (e.g., from the US and the UK), and also take into consideration estimates derived using a number of methodologies, both backward-looking and forward-looking.
80. The Panel agrees that the Commission should draw on international MRP estimates. New Zealand is a small, partially-integrated economy. New Zealand-only estimates would be particularly exposed to estimation error.
81. The Panel also agrees that it is appropriate to consider MRP estimates underpinned by different methodologies, but the relative weights each Panel member would attribute to the various approaches differs.
82. Professor Myers recommends that most weight be placed on MRP estimates based on historical returns (backward-looking methodologies). These estimates can be adjusted for long-term trends in price-dividend and price-earnings ratios.³² Forward-looking methods are difficult to implement and surveys hard to interpret.
83. Professor Franks recommends that, while primary weight should be given to backward-looking models, these estimates be attenuated by also considering forward-looking models. Forward-looking estimates may be less scientific and precise, but still are useful in attenuating backward-looking estimates.
84. Backward-looking estimates require attenuation because these are vulnerable to risk changes over time and outturns differing from expectations, potentially suffer from

³² Dimson, Marsh and Staunton (2008) find a long-term upward trend in price-dividend ratios and argue that this trend cannot continue in the long-term future. Thus they subtract the average return contributed by the trend from historical-average MRPs. This is one of several potential adjustments to their historical-average MRPs. See Table 12, p. 47. A similar downward adjustment could be made for long-run trends in price-earnings ratios. See the Morningstar 2007 Yearbook, p. 98.

survivorship bias, and can have large standard errors.³³ Professor Franks points out that UK regulators and companies use somewhat lower MRPs than the historical data would imply. Furthermore, respectable academic sources believe that estimates derived from historical returns overstate the MRP and should be adjusted down (Dimson, Marsh and Staunton, 2002, 2003, 2008). Academic surveys (such as Welch, 2000) also support such downward adjustments. Professor Myers agrees that the worldwide consensus is that future MRPs are expected to be lower than historical MRPs. Dr Lally agrees with these comments.

85. Dr Lally considers that all estimation methods have disadvantages and no method seems clearly best. Accordingly, he favours approximately equal weight should be applied to backward-looking estimates of the Dimson-Marsh-Staunton type, backward-looking estimates of the Siegel (1992) type, forward-looking estimates of the Cornell (1999) type, and survey results. Backward-looking estimates of the Merton (1980) type might also be considered, but these estimates are prone to considerable statistical uncertainty, and therefore may warrant lower weight.
86. Although some submitters on the Draft Guidelines (Professor Bowman; CRA) have called for increasing the Commission's present MRP estimate, the Panel considers that the Commission's present MRP estimate of 7% (for the simplified Brennan-Lally CAPM) is reasonable. Professor Franks points out that the Commission's estimate is higher than those generally adopted by regulators in the US and the UK, but is within appropriate bounds given the nature of the New Zealand economy.

Recommendation 21 The Panel recommends that the Commission continue to draw on international MRP estimates.

Recommendation 22 The Panel also recommends that the Commission retain its approach of examining both forward-looking and backward-looking estimates of the MRP.

Recommendation 23 Professors Myers and Franks recommend that primary weight be placed on backward-looking approaches, but agree that backward-looking estimates may require attenuation. Professor Franks places somewhat more weight on forward-looking techniques than does Professor Myers.

Recommendation 24 Dr Lally favours equal weight over a wide range of estimation methods including forward- and backward-looking methods.

Recommendation 25 The Panel considers that the Commission's present MRP estimate of 7% (for the simplified Brennan-Lally CAPM) is reasonable.

³³ In finance, *survivorship bias* is the tendency for failed companies or markets to be excluded from historical returns data. Survivorship bias for firms is avoided if returns on failing or disappearing firms are included until they fail or disappear. But survivorship bias can also affect entire markets, since stock markets from poorly performing economies are excluded from standard samples. Argentina is the classic example.

11 Debt betas

87. Within the CAPM framework, debt betas represent the systematic risk in debt returns, which arises from both default risk and maturity risk. Debt betas can affect cost of capital estimates in three ways: first, when converting estimated asset betas to equity betas (levering); second, when converting estimated equity betas of comparators into asset betas (unlevering); and, third, when estimating the firm's cost of debt. The Commission has traditionally assumed that debt betas are zero.
88. Professors Myers and Franks recommend that the Commission accept the fact that on average debt betas have been positive. Debt betas can be positive for two reasons. First, some interest rate risk is likely to be systematic. Second, default risk and market risk are connected, especially in highly geared companies, and where there is a significant debt premium, the debt beta is unlikely to be zero.
89. When the Commission utilises comparator firms to estimate a firm's equity beta, three steps are involved. Step one unlevers the equity betas of comparator firms to obtain asset betas. Step two uses these comparator asset betas to estimate the asset beta of the firm of interest. Step three re-levers this asset beta to obtain the firm's equity beta. Positive debt betas would enter into the processes of unlevering and re-levering.
90. Professor Franks argues that some regulators use a different approach to unlevering and re-levering than the one used by the Commission; zero debt betas are often assumed in step one described above, but non-zero debt betas are employed in step three. This leads to an inconsistency. The Commission should clearly describe its approach to unlevering and re-levering, spelling out the consequences of alternative methods. It should aim for consistency in both steps.
91. Dr Lally agrees that debt betas must be either ignored or recognised in both steps one and three. If they are excluded at both points, this may lower the cost of equity or raise it, depending upon the leverages and debt betas of the comparator firms and the firm of interest; so, there is no general tendency to overestimate the cost of equity. The effect upon the cost of equity may be quite small if comparator firms and the firm of interest have: (a) similar levels of leverage; and (b) similar debt betas. Furthermore, if debt betas are to be estimated, the definition of the market portfolio should be expanded to incorporate risky debt and this may prove to be difficult.
92. Professor Franks notes that recent empirical evidence suggests much lower estimates of the size of the maturity risk premium for companies with investment grade debt than the earlier literature of the 1980s suggests. An important aspect of the debate centres on the contribution of credit risk to spreads on corporate debt. Schaefer and Strebulaev (2007), and Naik et al. (2003), both find that credit risk only explains a modest proportion of the spread on investment grade bonds. For BBB bonds, Schaefer and Strebulaev estimate the debt beta to be only about 4 basis points.³⁴ Their estimates for non investment grade debt are significantly higher. At least up

³⁴ The debt beta in their Table 4 is calculated on the equity value rather than the value of the assets. Adjusting for this raises the debt beta to about 6 basis points.

until the recent credit crisis, an assumption of a zero debt beta for investment grade debt would not have been too bad an approximation.³⁵

93. Professor Franks notes that the large majority of regulators assume zero debt betas. There are important exceptions, however. The UK Civil Aviation Authority, the UK Competition Commission, the Queensland Competition Authority, and the Essential Services Commission of Victoria have all applied non-zero debt betas. OFCOM has considered the issue but not implemented a non-zero debt beta.
94. The Panel agrees that debt betas may be subject to estimation error. Also, a significant part of a bond's debt spread may be attributable to differences in liquidity. Fluctuations in maturity risk premiums may complicate estimation of debt betas.
95. The Panel agrees that the Commission ought to consider debt betas. If they are significant they should be included in the WACC estimation. If estimated debt betas are small, they may be ignored.

Recommendation 26 The Panel recommends that the Commission takes account of empirical estimates of debt betas. If debt betas are significant they should be included in the WACC estimation. This is particularly important for non-investment grade debt.

12 Estimation of asset betas

96. The Commission's current practice is to estimate asset betas directly (by regressing the firm's or industry's returns on a market index and then removing the effect of leverage), or through indirect methods (the use of local and/or foreign comparators) when direct estimation is infeasible or the estimated results are believed to be unreliable.
97. Professor Myers recommends that, when a sample of similar companies can be identified, industry betas should be estimated, as this will significantly improve the statistical reliability (lower the standard errors) of the estimates. If the companies in the industry sample are similar, any deviation of the asset betas of the individual firms from the industry average will be mostly noise. Industry asset betas often are a useful benchmark for estimating asset betas for individual companies.
98. Furthermore, Professor Myers recommends that industry betas should be estimated using returns on a portfolio of the sample companies, *not* solely as an average of individual company betas as the Commission presently does. This approach is desirable because the standard error of the industry estimate is readily obtained. Then the Commission could assess whether the beta of a single company in the industry differs from the industry average. This could be done by weighting the single company estimate against the industry estimate, taking account of both standard errors and also other information, such as differences in business mix, operating

³⁵ It may be that the increase in spreads on investment grade bonds during the recent period of turmoil in financial markets may reflect a more important contribution for credit risk in explaining the size of credit spreads. This would suggest higher debt betas than those estimated by Schaefer and Strebulaev. For evidence of the impact of the credit crisis on the systematic risk component in debt spreads, see The Bank of England (2008), p.256.

leverage and growth opportunities, to obtain a final estimate for the individual company.

99. Dr Lally is doubtful whether reliable adjustments can be made to industry average asset betas to account for intra-industry variations across firms in factors other than financial leverage (for example, operating leverage and growth options). Accordingly, if an estimated industry average asset beta is attributed to an individual firm, the estimation error here involves not only the error in estimating the industry average asset beta but the error arising from attributing the industry average to an individual firm; estimation of the standard deviation of the estimation error here then requires asset beta estimates for the individual firms within the industry. Accordingly, Dr Lally favours estimation of the industry average asset beta from the estimates for the individual firms within the industry. Furthermore, even if the estimate for an individual firm constitutes a weighted average of the estimated industry average and an estimate based upon only returns data for the firm of concern (following Vasicek, 1973), the estimated asset betas for each firm in the industry will still be needed to estimate the standard deviation of the estimation error.
100. Professors Myers and Franks warn that when betas are directly estimated using returns data, the Commission should be wary of bubble-type periods and periods where firm-specific leverage has changed significantly. Such events can bias forward-looking estimates of beta. For example, there is evidence that during the 1987 October Crash, correlations between returns on securities and the market portfolio changed significantly and generated biased beta forecasts.³⁶
101. In respect of changes in firm level leverage, Dr Lally recommends that estimated equity betas be converted into asset betas using the time-weighted average leverage over the estimation period rather than leverage at the end of the estimation period.³⁷ Professor Myers agrees with this recommendation.
102. On the issue of time-varying estimates, Professor Myers recommends that, for mature companies, the Commission should check betas estimated from monthly or weekly data over long periods, for example with a plot of rolling five-year betas. This would reveal any short-term anomalies, and whether normal betas are reasonably stable over time. Dr Lally agrees with this recommendation.
103. Professor Myers raises some objections to the description of the determinants of beta outlined in para 101 of the Draft Guidelines. First, on the issue of 'duration of contract prices', the Commission argues that the effect of long-term output price contracts on asset betas is ambiguous. This is incorrect. Such long-term contracts reduce asset betas (see Brealey, Myers and Allen, 2008, pp.249-250). Second, the discussion on the determinants of beta ignores interest rate risk. Long-lived assets are exposed to interest rate risk in much the same way as long-duration bonds and this risk can be partly market risk. Allowed rates of return and profits on utilities are traditionally 'sticky', which exposes investors in such assets to significant interest rate risk.

³⁶ There was an abrupt change in utility betas around the October 1987 Crash due to changes in correlation between the returns on the utility stocks and market returns. See Lauterpacht and Greenwood (1995).

³⁷ Further discussion of this issue appears in Lally (1998a).

104. Professor Franks argues that there is much judgment involved when estimating betas (particularly when indirectly estimating these), but this is unavoidable. He also suggests that where there has been significant volatility in capital markets, as is the case currently, the real asset betas of some regulated companies may have undergone changes which will not be captured by a long historical time series.

Recommendation 27 Professor Myers recommends that, where possible, asset betas be estimated for industries. Industry betas should be estimated from returns on a portfolio of the sample companies, not as an average of individual company betas. Industry betas are useful benchmarks for estimating asset betas for individual companies.

Recommendation 28 Dr Lally recommends the Commission use individual firm data to estimate the betas for individual firms followed by averaging of the estimated (asset) betas to generate the industry estimate.

Recommendation 29 The Panel cautions the Commission to be mindful of anomaly events over the estimation period.

Recommendation 30 Professor Myers and Dr Lally recommend that for mature firms the Commission check beta estimates, for example with a plot of rolling five-year betas, to reveal any short-term anomalies.

Recommendation 31 Professor Myers recommends revising some of the discussion in the Draft Guidelines on the determinants of beta.

13 Adjustments to beta for mean reversion

105. A number of submitters (Transpower; CRA) suggest that one approach to overcoming the generally large errors associated with beta estimates is for the Commission to apply some adjustments (such as Blume, 1971, 1975) that recognise the tendency for betas to revert over time towards a long-run mean of one.

106. Dr Lally recommends that the Commission not make such adjustments. He argues that Blume's corrections are designed to (a) address mean reversion, i.e., the tendency for the true equity betas of firms to shift towards 1 over time and (b) address 'order bias', i.e., the tendency for low (high) beta estimates to represent underestimates (overestimates).³⁸ However, in respect of mean reversion, the tendency observed by Blume in the period examined can readily be explained by phenomena that are irrelevant to the asset betas of specific types of activity. For example, if firms diversify into unrelated activities, then the asset betas of firms (but not those of specific activities) will converge towards 1. Alternatively, if there is a decline in the degree of cross-company variation in financial leverage, then the equity betas of firms (but not their asset betas) will converge towards 1. In respect of order bias, the Blume process disregards the industry from which the firm is drawn, and this induces upward bias in the beta estimates of low-beta firms and downward bias for high-beta

³⁸ See Lally (1998b) for further details.

firms (as shown in Lally, 1998b). The Vasicek (1973) procedure, which also addresses order bias, is not subject to this particular problem insofar as it uses industry average beta estimates. Furthermore, if beta estimates are sought for more than one firm within an industry, the use of either Blume or Vasicek beta estimates will give rise to different estimates for these firms, and this is not desirable.

107. Professor Franks is persuaded by international empirical evidence that equity betas tend to have unit mean-reverting properties. A number of beta services (Bloomberg and the London Business School Risk Measurement Service) include an adjustment for this (LBS uses the Vasicek adjustment). Professor Franks considers that the Commission ought to give some weight to the evidence on mean reversion and notes that some beta services make this adjustment in coming to a conclusion on what is an appropriate estimate.
108. Professor Myers agrees that order bias may be an issue. Observing a very low (high) beta estimate means that the estimation error is likely to be negative (positive). Therefore some sort of Bayesian adjustment is sensible. The Vasicek procedure is a good starting point for such an adjustment.

Recommendation 32 Dr Lally recommends that the Commission not make Blume adjustments to equity betas; even Vasicek adjustments are undesirable if beta estimates are sought for more than one firm in an industry.

Recommendation 33 Professors Franks and Myers agree that some form of Bayesian adjustment to beta estimates may be sensible, but do not strongly recommend a specific adjustment method.

14 Estimating betas for multi-divisional firms

109. When faced with a multi-divisional firm, where one or more of these divisions are subject to regulation, and others are not, the Commission has attempted to estimate betas (and, therefore, the cost of capital) for the regulated parts of the business by reference to comparators. However, disaggregating the beta of the whole enterprise into division-specific betas can be a challenging task.
110. Professor Franks proposes a number of approaches to deal with this issue:
 - (a) The ‘pure play’ approach involves estimating the asset betas of independent pure play businesses and matching those to each of the regulated and non-regulated divisions within the company.³⁹ This method works well when the regulated and unregulated businesses have a priori very different risks, and suitable pure play comparators exist.
 - (b) Estimate the ratio of operating leverage and revenue sensitivity for both the regulated and non-regulated activities of the firm. Use these estimated ratios to

³⁹ Ideally, one would estimate regulated and unregulated betas separately and combine them as a crosscheck to see if the amalgamated beta equals the company’s overall asset beta.

- disaggregate the group beta into one for the regulated and one for the unregulated businesses.
- (c) For a sample of independent companies, econometrically estimate a beta function (with asset betas as the dependent variable) specified as a function of particular variables that are drivers of beta risk (e.g. operating leverage and revenue sensitivity), and then use the coefficients from this estimated equation to predict the asset beta of the regulated divisions of the multipart business.
111. Professor Myers agrees with the approaches proposed by Professor Franks, although in his experience approach (c) is difficult to carry out successfully.
 112. Perfect pure play comparators do not exist. Professor Myers adds that it is often helpful to start with a benchmark comparator that the Commission understands well and then make necessary adjustments in order to estimate the regulated division's cost of capital indirectly.
 113. Professor Myers also emphasises the importance of clearly spelling out all the steps taken in choosing comparators and in making any necessary adjustments.
 114. Dr Lally agrees with approach (a) when suitable pure-play comparators exist. In their absence, the betas of multi-divisional firms embodying such pure-plays should be estimated and the underlying pure-play betas deduced through a cross-sectional regression.

Recommendation 34 Professors Franks and Myers recommend that the Commission estimate betas for multi-division firms either by (a) reference to 'pure-play' comparators; (b) reference to the ratio of operating leverage and revenue sensitivity for the regulated and non-regulated aspects of the firm; or (c) econometric techniques that seek to identify the key drivers of beta in a sample of independent firms.

Recommendation 35 Dr Lally recommends approach (a) when suitable pure-play comparators exist and otherwise recommends deducing these pure-play betas from the betas of multi-divisional firms embodying such pure-plays.

Recommendation 36 Professor Myers emphasises the importance of clearly spelling out all the steps taken in choosing comparators and in making any necessary adjustments.

15 Leverage

115. Leverage is used in WACC estimation in two places: (a) when transforming asset betas to equity betas (and vice versa) and (b) in calculating the capital structure weights in the WACC formula. The Commission presently estimates optimal leverage (in market value terms) by averaging across the capital structures of similar firms in the same industry, rather than using firms' actual leverage.
116. Professor Myers recommends that the Commission not attempt to optimise leverage for firms or industries, provided debt ratios sit within reasonable bounds. (It may be convenient and appropriate to standardize on an industry debt ratio for estimating the

cost of capital for all firms in the industry.) He argues that, in practice, the relationship between WACC and leverage appears to be ‘flat’ except at extremely high or low debt ratios, and the Commission should not intervene except at these extremes. Once WACC is estimated and the allowed rate of return determined, the regulated firm should be allowed to operate at any debt ratio within a reasonable range. (The same WACC can be used whether the Commission considers either efficient or actual costs in setting prices.) At extreme levels of debt, the Commission could seek to impose more appropriate leverage ratios.

117. Furthermore, if the Commission adopts the simplified Brennan-Lally CAPM, and marginal tax rates for corporations and investors are the same, there is no net tax advantage from borrowing. If the classical CAPM is adopted, tax advantages from borrowing may exist, but it should be recognised that taxes are only one consideration among many when firms select their capital structure. Most firms do not fine-tune their debt ratios to minimise tax (see Graham, 2000).
118. Professor Franks recommends that, since the tax benefit of debt is not the sole determinant of capital structure,⁴⁰ and because there are reasons to believe that not all the tax benefits of debt accrue to shareholders (Miller, 1977; Graham, 2000), the Commission should be cautious about clawing back (and distributing to consumers) all the tax advantages of leverage.
119. Professor Myers suggests that in instances where the firm is unlisted actual book leverage could be used as a reasonable proxy for the actual market value of leverage. If the firm is regulated appropriately, book values and market values should converge. Dr Lally agrees with this point, in respect of regulation, as opposed to ex-post assessments of excess profits.
120. Professor Franks recommends that, in certain special circumstances (for instance, when the regulated firm is part of a group with risky non-regulated businesses, or if the group wishes to operate at a very high overall debt ratio, thus putting the regulated business at risk), the Commission may wish to ‘ring-fence’ the regulated assets of the firm rather than impose a more sensible leverage ratio on the firm as a whole.⁴¹ This ring-fencing would have to be reflected in the covenants of the loan agreements. In addition, the regulator may wish to impose clauses like a lock-up on dividends if the debt rating falls below investment grade. OFGEM and OFWAT in the UK have imposed precisely this type of condition on regulated firms in their respective industries. In addition, a specific insolvency regime has been put in place that allows the insolvency administrator (the ‘special administrator’) to take account of customer interests as well as those of creditors in making investment decisions.
121. The restrictions mentioned in the previous paragraph can be most efficiently applied when the regulated firm has a license to operate, granted by the regulator. We understand this is not the case in New Zealand. When firms engage in highly

⁴⁰ For instance, firms may issue debt as an internal disciplining device in response to the agency costs of free cash flows (see Jensen, 1986, and Brealey, Myers and Allen, 2008, pp. 521-522).

⁴¹ For example, Enron held a UK water company at the time it went bankrupt. Because OFWAT insisted on ring-fencing the water company, there was little or no effect on that firm arising from the Enron bankruptcy.

leveraged transactions and the regulated firm is part of a larger group with non-regulated activities, the absence of a license and related conditions for operations may prove a serious disadvantage if the group becomes distressed.⁴²

122. Such considerations are particularly important since a regulated firm can easily redistribute default risk away from itself towards the regulator, and towards consumers by seeking higher prices from the regulator in order to avoid bankruptcy if faced with the prospect of financial distress.⁴³ Ring-fencing mitigates this problem by insulating the regulated assets of the firm.
123. Professor Myers agrees with Professor Franks's suggestion.
124. Dr Lally considers that actual leverage should be used (where possible) if the regulatory process generally employs actual costs, whereas 'optimal' leverage should be invoked if efficient costs are generally employed. However, there is some evidence that firms' leverage levels reflect the random outcomes of past investment decisions (pecking order theory) as well as assessments of what is optimal. Consequently, 'optimal' leverage should be estimated by averaging over the actual leverage levels of firms in the relevant industry. Any errors resulting from imposing a uniform leverage level on all firms within an industry would be slight when the simplified Brennan-Lally CAPM is used because the allowed WACC is almost invariant to leverage in that case.

Recommendation 37 Professor Myers recommends the Commission use actual rather than 'optimal' leverage when estimating the cost of capital for firms or industries, unless firms have adopted extremely high or low debt ratios. Book values rather than market values could be used if the firm is unlisted.

Recommendation 38 Dr Lally favours actual leverage when firms' actual costs are generally employed and 'optimal' leverage when efficient costs are generally employed with the latter estimated from the average leverage of firms in the relevant industry.

Recommendation 39 Professors Franks and Myers suggest that the Commission consider ring-fencing the regulated assets of the firm to protect them from bankruptcy and minimise the costs of distress.

Recommendation 40 Professors Myers and Franks suggest that in addition the Commission consider requiring firms to maintain investment-grade credit ratings and including lock up clauses for dividends when the debt is rated non investment grade.

⁴² An example of a company that owns regulated assets in New Zealand and has substantial other non-regulated assets is Babcock and Brown. Recently it has experienced a significant deterioration in credit quality.

⁴³ This situation occurred in the UK when the CAA was forced to give price concessions to the National Air Traffic Services (NATS) when it faced financial distress.

16 Estimation of the cost of debt

125. The Commission estimates the cost of debt as the sum of a risk-free rate and a debt premium, which reflects the marketability of corporate bonds and the risk of default.
126. Professor Myers recommends that debt premiums should be estimated from the spreads of plain-vanilla, medium-term new-issue bond yields vs. government bond yields of similar maturity. The same risk-free rate used to estimate the cost of equity in the CAPM formula should be used to measure this spread. If the firm wishes to issue longer-term debt, or debt that is not plain-vanilla (e.g. convertibles), the Commission should permit this. No adjustment is required in efficient capital markets (absent some specific subsidy or tax advantage).
127. One submitter (NERA) argued that the Draft Guidelines are ambiguous over whether allowed debt premiums in the cost of debt should reflect the term of debt held by the firm or the length of the regulatory period. NERA favours the Commission selecting debt margins that reflect the term of the firm's debt.
128. Dr Lally favours estimating the debt premium using a term for debt corresponding to the greater of the regulatory cycle and the actual term of the firm's debt, on the grounds that an appropriate course of action for the firm is either to (a) match the term of debt to the regulatory cycle or (b) choose a longer term for debt coupled with swap contracts to match the duration of the debt to the regulatory cycle. Professor Franks agrees with this point.
129. Professors Franks and Myers agree with footnote 32 of the Draft Guidelines, which says that, strictly speaking, the cost of debt should be defined as the expected rather than promised yield on debt, but in practice the expected yield is not easy to estimate. So, in most situations (unless the debt premium is very high, due to a high risk of default), promised yields can be used as proxy for expected yields.
130. Dr Lally favours promised yields over expected yields in principle because promised yields incorporate allowance for bankruptcy costs (although they overcompensate for them because the margin of promised over expected yield reflects not just bankruptcy costs but also the default option possessed by equity-holders).⁴⁴
131. Some submitters (Professor Bowman; NERA) argue for inclusion of an allowance for debt issuance costs within the cost of debt. Dr Lally agrees with this suggestion, and notes that allowance through cash flows (unless amortized) suffers from the disadvantage of assigning the costs to the periods in which they are paid rather than to the entire life of the debt. However, allowance through the cost of debt requires that any such costs be excluded from cash flows.

⁴⁴ Promised yields reflect expected default losses to bondholders and default losses are aggravated by bankruptcy costs. For example, the administrative costs of a bankruptcy reduce the funds available to be paid out to bond holders and therefore increase the default losses suffered by bond holders. So, promised yields incorporate allowance for bankruptcy costs. However, promised yields also reflect the default option possessed by equity holders, i.e., the limited liability protection that equity holders possess, which raises the promised yield on debt.

132. Professor Franks considers that an allowance should be given where the refinancing can be justified. Sometimes the costs may not be insignificant; however, the Commission should be mindful not to reward firms for reckless or imprudent refinancing. Incentives matter.
133. Professor Myers considers that debt (or equity) issuance costs should not be rolled into the cost of debt (equity) rates. Instead, he recommends they be treated as cash investments to be amortized over the life of the issue (or over average asset life in the case of equity issue). In other words, these costs should be handled through the regulatory cash flows and not the WACC.

Recommendation 41 Professor Myers recommends that debt premiums should be estimated from the spreads of plain-vanilla, medium-term new-issue bond yields vs. government bond yields of similar maturity.

Recommendation 42 Dr Lally recommends that a firm's allowed debt premium should be based upon debt with a term equal to the greater of the regulatory cycle and the actual term of firms' debt.

Recommendation 43 The Panel agrees that in most situations it is appropriate for the Commission to define the cost of debt in terms of promised rather than expected yield on debt.

Recommendation 44 Dr Lally recommends that the Commission include in the cost of debt any debt issue costs incurred by the firm.

Recommendation 45 Professor Myers recommends the Commission handle debt issue costs through the regulatory cash flows and not the WACC.

17 Taxation

134. The Commission presently uses a tax-adjusted WACC model, accounting for taxation through the cost of capital rather than in regulated cash flows.⁴⁵ The Commission employs two tax rates in the calculation of WACC: (a) the investor tax rate in the Brennan-Lally CAPM and (b) the corporate tax rate in the cost of debt.
135. On the treatment of (b), Professor Myers points out that it is not always straightforward to identify the correct marginal company tax rate (e.g. where the firm has accumulated tax losses). In such cases, he recommends the Commission take taxes out of the WACC formula and treat all taxes paid on net income (after interest) as an expense; the pre-tax debt cost k_d would replace the after-tax debt cost $k_d(1-T_c)$. By employing a 'vanilla' WACC, taxation could then be accounted for in

⁴⁵ The tax-adjusted WACC model used by the Commission has the form:

$WACC = k_e(1-L) + k_d(1-T_c)L$, where k_e is the cost of equity, k_d is the cost of debt, L is the financial leverage ratio, and T_c is the corporate tax rate.

the regulated cash flows. This recommendation is in line with suggestions made by some submitters (Marsden Jacob Associates; NERA).

136. Both Professor Franks and Dr Lally agree that when a company faces tax complications, such as tax losses, it would be cleaner to deal with these through the regulated cash flows rather than through the cost of capital. In the absence of such tax complications, it does not matter in principle whether the treatment occurs via the cash flows or the discount rate.
137. One submitter (PWC) argued that the Commission's assumption that the parameter T (the average marginal tax rate on ordinary income across all equity investors in the New Zealand economy) in the simplified Brennan-Lally CAPM has zero variance is inappropriate. Dr Lally agrees with this point and recommends the Commission take into account uncertainty over this parameter.

Recommendation 46 The Panel recommends that when firms face tax complications, such as tax losses, it is cleaner to treat taxation through the regulatory cash flows rather than the cost of capital rate.

Recommendation 47 Dr Lally recommends the Commission take into account uncertainty over the tax parameter T in the simplified Brennan Lally CAPM model.

18 Modeling estimation errors

138. Boyle et al. (2006) argue that when there is no direct relationship between the WACC parameter being estimated and the data being used (e.g., when using foreign market returns to estimate the New Zealand MRP; or when using comparator firms to estimate the regulated firm's asset beta), two sources of estimation error arise: (a) sampling error; and (b) intrinsic variation deriving from firm-specific or economy-specific characteristics, regulatory regimes, etc. It is argued that both components need to be considered when estimating a parameter.
139. Dr Lally agrees with this argument and suggests rewording para 106 of the Draft Guidelines to recognise the tradeoff between reduced sampling error and increased intrinsic variation when employing comparators in the estimation process.
140. Professor Franks is also sympathetic to the arguments raised by Boyle et al. Alexander et al. (1996) provide a classification of jurisdictions by regulatory risk. They find that the US, where rate revisions occur frequently, has low regulatory risk, whereas utilities in the UK, with its five year regime, are exposed to higher risk. These cross-country differences would drive intrinsic variation in asset beta estimates. In addition, US capital markets are significantly larger and more diversified (lower risk) than New Zealand capital markets, and although Australia and New Zealand have geographically proximate economies, industries within these countries will tend to vary greatly. These differences would tend to drive intrinsic variation in MRP estimates.

141. Hence, intrinsic variation is real. However, the use of judgment is unavoidable for the Commission when dealing with this issue.

Recommendation 48 Dr Lally and Professor Franks recommend that the Commission take into account both sampling error and intrinsic variation when estimating WACC parameters. Professor Franks considers that judgment in this regard is unavoidable.

19 Confidence intervals around point estimates

142. Typically, the Commission is faced with uncertainties (model and parameter uncertainty) over the estimates of the key variables in the WACC formula. The Commission has in the past attempted to (a) estimate the standard errors on these individual parameter estimates – usually significant judgment is required here;⁴⁶ and (b) make reasonable assumptions about the degree of correlation between the various components of WACC. Then the Commission derives an overall WACC distribution, which gives the Commission a range from which to select a WACC value.
143. Professors Myers and Franks accept the process of estimating standard errors for each of the parameters underlying WACC, and using these as inputs to describe the uncertainty over the overall WACC. However, describing the resulting number as a standard error gives a false sense of rigour, when in fact judgment is unavoidable.
144. Professor Myers argues that there are so many uncertainties surrounding the parameters underlying WACC, many of which cannot be quantified, that describing the confidence bands around WACC in terms of standard deviations and percentiles provides a misleading sense of precision; this may in turn open the Commission up to unnecessary criticism.⁴⁷
145. Therefore, Professor Myers and Franks recommend describing the uncertainty surrounding WACC estimates in terms of a ‘plausible range’, rather than standard deviations or an exact statistical distribution.
146. Professor Franks points out that UK regulators prefer to quote a range for estimates rather than standard deviations surrounding a point estimate.
147. Dr Lally favours the Commission’s present approach to estimating the overall WACC distribution, as described above.
148. Dr Lally considers that even if a plausible range for WACC is to be estimated, then the best basis for forming it is to first estimate the standard deviation and mean for the WACC distribution based upon the estimates for the individual parameters (this

⁴⁶ For example, the Commission not only produces a point estimate of the MRP, but also attempts to quantify the standard deviation surrounding that point estimate. Standard errors for backward-looking estimates are computable, but standard errors for forward-looking estimates rely on judgment.

⁴⁷ The many uncertainties surrounding estimates of parameters that underlie the WACC include uncertainty over model choice (CAPM vs. ICAPM or DCF estimates), the MRP and the maturity premiums imbedded in the term structure of interest rates.

process is purely mathematical) and then exercise judgment in forming the plausible range.

149. Furthermore, Dr Lally considers that the inability to formally account for all sources of uncertainty could be addressed by some qualitative recognition of these additional sources of uncertainty.
150. Dr Lally also notes that the Commission's earlier practice of attempting to specify merely plausible bands induced the criticism of being ad hoc. Professor Franks acknowledges this point but considers that such criticism should be viewed as healthy and result in constructive engagement with submitters. Professor Franks recommends that one compromise is to estimate a plausible range, but to calculate standard errors as a way of informing the range but not determining it.
151. Professors Franks and Myers agree that the unquantifiable nature of some of the uncertainties discussed in para 138 means that the exercise of judgment is unavoidable. However, the Commission should exercise its judgment in a transparent manner by describing fully any adjustments contemplated, and its decision criteria for selecting adjustments.

Recommendation 49 The Panel agrees with the Commission's current approach of estimating standard errors for each variable underlying the WACC. However, Professors Myers and Franks recommend that when the Commission combines these parameters it frame its overall WACC estimate in terms of a 'plausible range' rather than in terms of standard deviations and percentiles, in acknowledgment of the numerous (parameter and model) uncertainties in the estimation process.

Recommendation 50 Professors Myers and Franks recommend that the Commission fully describe any adjustments used in combining individual parameter estimates and determining a plausible WACC range.

Recommendation 51 Dr Lally favours the Commission's current practice of describing the uncertainty around the WACC estimate in terms of a standard deviation but it should accompany this with some qualitative recognition of additional sources of uncertainty.

20 Use of Monte Carlo simulation for estimating WACC

152. A number of submitters (Boyle et al, 2006; CRA on behalf of Vector) recommended the Commission use Monte Carlo methods to simulate the WACC distribution, rather than the approach described in Section 19.⁴⁸ It was argued that Monte Carlo techniques permit joint variation in parameters, and therefore provide a useful means of testing the effect of combinations of variable settings that underlie the WACC.

⁴⁸ *Monte Carlo simulation* is a technique used to estimate the probability distribution of a random variable. Monte Carlo simulates the results of a model or process by accumulating average results of thousands of random draws from the probability distributions of input variables.

The Commission has not used Monte Carlo simulation to date in estimating the WACC.

153. Dr Lally's view is that the only potential gain from adoption of a Monte Carlo approach would be to enable a range of possible distributions for individual parameters to be considered. However, a more efficient approach to this issue would be to consider a range of possible distributions for WACC that are consistent with the estimate for its mean and standard deviation, and doing this suggests that the impact upon the relevant part of the WACC distribution (the 50th to 90th percentiles) is slight.
154. Professor Myers also sees no significant gains from employing Monte Carlo methods for the purposes of estimating WACC. He argues that Monte Carlo techniques are typically used to evaluate a system in which variables interact in a complex manner, and where obtaining a direct (closed-form) solution to the system is not feasible. However, Professor Myers does not see any complex feedback loops in the interaction between WACC variables that warrant the use of Monte Carlo simulation. Obtaining direct estimates and reasonable ranges for WACC is feasible without Monte Carlo techniques.

Recommendation 52 Professor Myers and Dr Lally consider that there would be no significant additional benefit to the Commission (over its present approach) in employing Monte Carlo simulation techniques to estimate WACC distributions.

21 Choosing an overall WACC value

155. As a general principle, the Commission considers that the costs of setting allowed returns too low outweigh the costs of setting them too high. Therefore, the Commission generally chooses WACC values either equal to, or greater than, the midpoint of the estimated range. Professors Myers and Franks agree with this principle.
156. Dr Lally's view is that the Commission needs to specify a WACC value that is strictly greater than the midpoint of the range, not simply equal to it. Several submitters (ABN AMRO; JB Were; LECG; NERA; PWC; Transpower; Vodafone) have urged the Commission to consistently select values from the upper end of the estimated WACC range.
157. Professor Franks recommends that the Commission evaluate how far to set the allowed return above the midpoint of the range on a case-by-case basis. For example, the Commission might take different approaches to a regulated company that is exposed to competition and one that is not.

Recommendation 53 Professors Myers and Franks agree with the Commission's policy of setting the WACC equal to, or greater than, the midpoint of the estimated range, in recognition of the asymmetric costs of setting the WACC too low.

Recommendation 54 Dr Lally recommends that the Commission choose WACC values that are strictly greater than the midpoint of the range.

Recommendation 55 Professor Franks recommends that the Commission evaluate how far above the midpoint of the range it moves on a case-by-case basis.

22 Treatment of asymmetric risks

158. The Commission recognises that regulation (and competition) imposes asymmetric risks on regulated firms by capping profits without providing commensurate insulation from downside risk. Firms may also be exposed to stranding risk (through technical obsolescence, unfavourable demand shocks or regulatory optimisation) and to large catastrophic events such as natural disasters. The Commission's view has been that unregulated firms will typically seek compensation for such risks by adjusting their prices, either ex ante or ex post. The Commission provides compensation for asymmetric risks, on a case-by-case basis, and prefers to do so by adjusting the regulatory cash flows rather than adding a margin to WACC.
159. All three Panel members agree that asymmetric risks are real, potentially have large impacts on the firm, and therefore should not be ignored by the Commission.
160. Asymmetric risks may be classified into two categories:
- (a) **Type I** risks are risks that are generally unrelated to the day-to-day operations of the firm, and arise through infrequent events that could produce large losses. Examples include natural disasters; pandemics; terrorist threats; or large, unexpected policy shifts that could force the shutdown of operating plant before the end of its economic life, such as the introduction of a stiff carbon tax.
 - (b) **Type II** risks are risks that derive from the threat of competitive entry or regulation when the firm is performing 'too well'. Competition or regulation limit the upside but not the downside. On the downside, assets can become stranded through technical innovations that unexpectedly lower operational costs or through negative demand shocks. Such events represent significant downside risk to the business. Competition and regulatory intervention caps any significant upside to the firm, but not the significant downside.
161. Professor Myers recommends that the burden of proving such risks should not fall entirely on the firm, as argued in the Draft Guidelines. The Commission should, through its own initiative, explore methods of compensating for such risks. Dr Lally considers that the Commission is at a serious disadvantage to regulated firms in assessing the extent of type II asymmetric risk. So, firms should be invited to submit an estimate of the allowance for the Commission's consideration.
162. Some submitters (Vector; Vodafone) have suggested that the Commission should choose WACC values from the upper end of the estimated range, in recognition of asymmetric risks. Dr Lally disagrees with this approach on the basis that the WACC distribution is a reflection of uncertainty over the true WACC value, and therefore should not be used to deal with the unrelated issue of an appropriate allowance for asymmetric risk. Professor Myers is in agreement with Dr Lally on this issue.

163. Professor Myers argues that the view expressed in the Draft Guidelines that unregulated firms may seek either ex post or ex ante compensation for asymmetric risks is potentially misleading. Unregulated firms are forced to seek compensation for such risks ex ante, because competition prevents firms from raising prices to cover such losses once these costs become sunk (the exception is an industry-wide adverse event that raises costs to all rivals). (One submitter, Vector, argued that ex post recovery may be inequitable, allocatively inefficient, and potentially infeasible.) In competitive markets, compensation for asymmetric risk normally comes ex ante.
164. Professor Myers argues that ideally compensation for regulated firms should also occur ex ante. But in practice the size of the premium will be hard to justify to regulators, so some combination of ex post and ex ante compensation will be unavoidable. The form of compensation should depend on the nature of the risk.
165. Professor Myers recommends that type I risks could be handled by allowing regulated firms to charge an 'insurance premium' that is invested in a reserve fund, which would pay out in the event of a type I occurrence (effectively, a form of self-insurance that mimics what might otherwise occur, absent regulation). If the fund turns out to be inadequate, the Commission could allow some ex post compensation. If the fund accumulates too much money, part of the fund could be returned to consumers. Estimates of the size of this allowed premium could come from the reinsurance market. Professor Franks and Dr Lally agree with this suggestion. However, Professor Franks believes that if this approach proves infeasible the Commission should consider alternatives, including choosing a WACC above the midpoint of the range.⁴⁹

Recommendation 56 The Panel agrees that asymmetric risks are real, potentially have large impacts on value and profitability, and therefore should not be ignored by the Commission.

Recommendation 57 The Panel recommends that a reserve fund could be established to compensate firms for type I risk, with ex post top-ups (or redistributions) if the fund proves inadequate (runs into surplus).

Recommendation 58 Professor Myers recommends that the burden of proving asymmetric risks should not fall entirely on the firm, as argued in the Draft Guidelines.

Recommendation 59 Dr Lally recommends that since firms are best placed to assess the degree of type II asymmetric risk they face, they should be invited to submit an estimate of the allowance for the Commission's consideration.

Recommendation 60 Dr Lally and Professor Myers agree that the WACC distribution simply reflects uncertainty over the true WACC value, and therefore should not be used to deal with the unrelated issue of an appropriate allowance for asymmetric risk.

⁴⁹ Some parties may object to the investment fund in that it may discourage the regulated firm from managing the effects of catastrophic risk. In addition, there may be disagreements over how to measure the effects of catastrophic risk. Measurement problems may be particularly acute when there are a series of events attributable to terrorism, which although not individually large, have in aggregate a significant impact on the firm.

Recommendation 61 Professor Franks agrees in principle with Recommendation 60 but would not exclude such an adjustment if alternative provisions for type I asymmetric risk cannot be agreed.

23 Type II risk and timing options

166. Professor Myers points out that ‘type II asymmetric risks’ and ‘timing options’ are closely related and overlapping issues. (For this reason, it is recommended that the Guidelines combine the discussion on these two topics.)
167. Type II asymmetric risks are large in industries characterized by long-lived, irreversible (large sunk cost) investments, and substantial uncertainty (over future demand, costs, or technology shifts that would change the operating costs of later facilities). (Short-lived investments can be treated almost as reversible investments, as these are renewed frequently.) Real options theory suggests that in industries with such features, firms will not enter (invest) when the (conventionally calculated) NPV of doing so is zero.⁵⁰ Instead, firms will wait until expected profits are large enough to cover both the cost of capital and the type II asymmetric risks associated with entry. Such delay occurs in competitive industries, and is efficient. Hence, the presence of type II asymmetric risk creates a timing decision.
168. Professor Myers argues that regulation should recognise this investment rule and compensate firms for the type II asymmetric risk they bear. If the Commission adequately handles type II asymmetric risks (including its effect on investment timing), it would automatically be compensating firms for any relevant extinguished timing options; no further treatment for timing options is required.
169. Professor Myers recommends that the Commission should only compensate firms for timing options extinguished in response to type II asymmetric risk (asymmetric options); timing options that are exercised in the face of symmetric risk are a manifestation of market power, and regulators should not provide compensation for these.⁵¹
170. However, the real world is characterized by neither perfect monopoly nor perfect competition. Firms generally have some degree of market power and, therefore, enjoy a mixture of symmetric and asymmetric timing options. When the firm is exercising a timing option in response to a symmetric risk, when the investment is largely reversible (few sunk costs) or when there is little uncertainty about the future, the Commission should not provide additional compensation (regulation should assume investment takes place when the NPV equals zero). Professor Franks agrees with Professor Myers’s view on this issue.

⁵⁰ ‘Conventionally calculated’ refers to ordinary DCF procedures, which assume symmetric payoff distributions.

⁵¹ *Symmetric risk* means that downside risks are offset by possible upside outcomes. Symmetric timing options require some kind of market power deriving from franchise or patent rights, or specialised assets – something that releases (or at least partially insulates) the firm from the threat of competitive entry.

171. Professor Myers suggests that the Commission provide ex ante compensation for type II asymmetric risk via the firm's allowed cash flows; as mentioned earlier, unregulated firms are limited from implementing ex post recovery due to competitive pressures. One possible technique for calculating compensation for type II asymmetric risk is described in Hausman and Myers (2002).
172. Dr Lally agrees that timing options exercised in the face of symmetric risk are a manifestation of market power and regulators should not provide compensation for these. He also agrees that type II asymmetric risk potentially warrants compensation. However, he considers that the crucial feature of the latter case is the asymmetry in the cash flows rather than the presence of a timing option.
173. Para 153 of the Draft Guidelines argues that adding a margin to a firm's WACC would not necessarily ensure the optimal timing of investment; and that given the firm would receive the margin irrespective of when it invested, it would, if it had market power, be encouraged to invest at the earliest possible time, as opposed to delaying, to ensure that it maximises the period for which the margin was earned.
174. Professor Myers argues that firms would not bring forward investment in this way if they face type II asymmetric risk from regulation or competitive entry. But he agrees that simply adding a 'fudge factor' to the cost of capital does not solve the type II asymmetric risk problem.
175. Boyle et al. (2006) argue that even if there were no WACC premium that results in socially-optimal investment timing, there may be one that results in investment timing that raises overall welfare beyond that achieved without a WACC premium. Dr Lally agrees with this point and therefore recommends para 153 should be deleted from the Guidelines.
176. Professor Franks is of the view that mechanically adjusting the WACC for lost timing options is difficult and is too blunt an instrument, and is therefore undesirable. (Professor Myers agrees.) Rather, he recommends that the Commission engage with firms to first ascertain whether the problem is significant, and then try to value the NPV of the option to delay (an approach similar to Brennan and Schwartz (1985) for gold mines). Then, using this present value, allowed revenue streams for the company may be adjusted. Admittedly, techniques for calculating option values can be complex. However, the detriment from ignoring these may, in some instances, be large.
177. Professor Franks considers that, in the face of company requests and evidence in support of adjustments for extinguished timing options, it is helpful, if not essential, for the Commission to have impartial evidence on the size of the value of any claimed timing options.
178. He also suggests that the Commission might encourage industry groups to commission an industry-specific academic study on the issue of type II asymmetric risk or timing options. Alternatively, the Commission could itself initiate such a study. To the extent that they exist, it may also be useful to consider precedents set by other regulators, who have made specific provision for these factors.

Recommendation 62 Professor Myers recommends that the Commission only compensate firms for timing options extinguished in response to type II risk (asymmetric options); timing options exercised in the face of symmetric risk are a manifestation of market power, and regulators should not provide compensation for these.

Recommendation 63 Professor Myers suggests that the Commission provide ex ante compensation for type II asymmetric risk via the firm's allowed cash flows.

Recommendation 64 Dr Lally agrees that timing options exercised in the face of symmetric risk are a manifestation of market power and regulators should not provide compensation for these. He also agrees that type II asymmetric risk potentially warrants compensation. However, he considers that the crucial feature of the latter case is the asymmetry in the cash flows rather than the presence of a timing option.

Recommendation 65 Professor Franks recommends that any allowances for extinguished timing options be made through the regulatory cash flows.

Recommendation 66 Professor Franks recommends that the Commission seek impartial advice when assessing the size of any claimed option values. Further, he suggests the Commission could initiate, or encourage industry groups to commission, academic studies into the importance of type II asymmetric risk and timing options in specific industries; precedent from other regulators on the treatment of such issues may also be instructive.

24 Other real options

179. The Draft Guidelines recognise that although investment extinguishes timing options, it may also create abandonment and/or growth options, which may warrant a countervailing reduction in the cost of capital.
180. Dr Lally argues that, in respect of growth options, measurement difficulties suggest that firms should be left with these (i.e. there should be no attempt at any deduction for them). This helps to balance against other issues for which no adjustment is made and which are unfavourable to the firms.
181. Dr Lally and Professor Myers note that abandonment options mitigate type II asymmetric risk because they truncate losses. Thus, if type II asymmetric risk is recognised, any assessment of the required compensation should recognise that the abandonment option reduces downside risk.
182. Professor Franks acknowledges that abandonment options might offset the value of timing options, but without a detailed study of the industry (as suggested in Section 23), sees no way of quantifying this offset.
183. Professor Myers argues that the Commission may in fact want to reward firms for exercising flexibility. For instance, suppose the regulated firm has a choice between building one large base-load electric plant, or some smaller modular plants. Suppose also that there is significant uncertainty over demand or construction costs, and once built, investment costs are sunk. The first option provides the firm with economies of scale, whereas the second provides flexibility through sequential investment and the

option to abandon the investment program if adverse new information arrives. Given uncertainty and irreversible investment, the efficient ex ante strategy might very well be to build small modular units. After the fact it might look like these were inefficient.

184. In such cases, the Commission may wish to avoid penalising the firm for implementing a sequential investment strategy by making deductions for the abandonment and growth options such a strategy generates, because staggered investment may be optimal ex ante. In fact, imposing a penalty would distort incentives for such desirable behaviour to occur in future.

Recommendation 67 Dr Lally recommends that the Commission should not make any deductions for growth options, but should take into account the offsetting effect of abandonment options when making an assessment of type II asymmetric risk.

Recommendation 68 Professors Myers and Franks acknowledge that abandonment options can mitigate type II asymmetric risk, but Professor Franks sees no way of quantifying this offset without conducting a detailed study of the issue.

Recommendation 69 Professor Myers recommends the Commission may wish to reward firms for exercising (ex ante) optimal flexibility.

25 Costs of financial distress

185. Regulated firms have argued before the Commission that firms that face losses on a particular project may find it costly or even impossible to raise further funds from capital markets. Yet without such funds, firms may be forced to forgo future valuable projects, or shut down existing ones. The argument often advanced to the Commission is that the potential loss of value on forgone investments imposes additional costs on investors, for which they should be compensated. The Commission's current position is that the burden of proof in demonstrating such adjustments ought to be made lies with the firm.
186. Professor Myers acknowledges that financial distress can constrain investment. However, he argues that such prospects should not significantly affect the cost of capital, provided allowed returns cover the cost of capital and the firm adopts a reasonable debt ratio.
187. He adds that sometimes even conservatively financed regulated companies are forced into financial distress by a perfect storm of adverse events. (PG&E's bankruptcy during the California energy crisis is an example.) Such meltdowns are rare, however, and are best dealt with on a case-by-case basis.
188. Professors Franks and Myers recommend that, in general, the Commission not allow any explicit adjustment for financial distress costs, provided: (a) regulated firms operate at reasonable gearing levels; (b) the Commission does not claw back all the tax benefits of leverage; and (c) an investment grade debt rating is maintained by firms.

189. Dr Lally agrees with this conclusion, but notes that preservation of a minimum debt rating and/or a maximum leverage level can never fully protect against the possibility of financial distress. Furthermore, he notes that the use of promised rather than expected yields on debt within the WACC implicitly represents some recognition of financial distress costs.
190. Professor Franks considers that, in some exceptional instances, some firms' debt may be of junk status, even at low levels of gearing. As a result, the firm may only be able to raise capital at very high cost, and this may significantly increase bankruptcy risk. In such circumstances, the firm may require some explicit allowance for distress costs. Professor Franks notes that Almeida and Phillipon (2007) estimate the costs of financial distress for US listed firms as a percentage of market value for different levels of leverage and rated debt. This is a useful starting point in estimating any allowances for distress costs. However, the Commission needs industry-specific (and New Zealand-specific) estimates, by company size. One suggestion is to initiate an academic study on this topic.

Recommendation 70 The Panel recommends that, in general, the Commission not provide any explicit adjustment for financial distress costs, provided: (a) regulated firms operate at reasonable gearing levels; (b) the Commission does not claw back all the tax benefits of leverage; and (c) an investment grade debt rating is maintained by firms.

Recommendation 71 Dr Lally notes that the use of promised rather than expected yields on debt within the WACC implicitly represents some recognition of financial distress costs.

Recommendation 72 The Panel considers that the Commission could make adjustments for distress costs in exceptional circumstances, on a case-by-case basis.

26 Resource constraints

191. It has also been argued to the Commission that some firms are unable to undertake all desirable projects due to resource constraints, such as limited managerial talent. Thus, undertaking one project may sacrifice other desirable projects, and this foregone opportunity is an additional capital cost associated with the current project (i.e., investors implicitly recognise these costs when assessing their investment hurdle rates). The Commission's current position is that the burden of proof in demonstrating such adjustments ought to apply lies with the firm.
192. Professor Franks is uncomfortable with making adjustments to the cost of capital for resource constraints. He argues that, in principle, capital rationing should not occur in efficient capital markets. Even if it does the company can seek to be acquired or enter joint ventures. He is doubtful that the consumer should pay for any of these costs. A firm may impose capital rationing on itself for many reasons, such as managerial constraints that do not derive from capital markets. There are exceptions. For example, when a firm is highly geared and has risky debt outstanding and may

wish to raise equity, it may face a debt overhang problem arising from potential wealth transfers between debt and equity holders. However, Professor Franks does not consider the Commission should make allowance for even this problem, absent exceptional circumstances.

193. Dr Lally's view is that resource constraints that induce the sacrifice of positive NPV projects seem to be evidence of market power, and therefore firms should not be compensated for them. Furthermore, resource constraints in general lead to a rise in the market price of the resource, which eliminates the constraint and raises the cost of any activity using that resource. The cost of regulated activities using such resources should reflect the (higher) price of these resources.
194. Professor Myers recommends that the Commission should not give any extra allowance for capital constraints. If necessary the firm can ring-fence regulated investment and finance it separately. Other resource constraints could be relevant, however, if they represent intangible assets with an opportunity cost. For example, if the firm has skilled technical staff that can only be used on one project, then devoting the staff to the regulated project has a real opportunity cost. In this case the Commission could regard the staff's time as an extra investment in the regulated project.

Recommendation 73 Professor Franks and Dr Lally recommend that the Commission not adjust the cost of capital for resource constraints.

Recommendation 74 Professor Myers recommends that the Commission not give any extra allowance for capital constraints, but considers compensation could be warranted for constraints on intangible assets with a real opportunity cost, such as constraints on the time of skilled technical staff.

27 Overall cost of capital sanity check

195. Professor Franks suggests that the Commission may wish to use a financeability test at reasonable, notional capital structures as a sanity check, to see whether the proposed price caps can service the debt, at an appropriate rating, for example, investment grade.⁵² If they cannot, the debt levels assumed in the notional capital structure should be reviewed to deem if they are unreasonable. If they are reasonable, it maybe that the price cap should be altered to rephase the cash flows between two regulatory cycles but in an NPV-neutral way. A continued failure to meet the financeability test may raise questions about the reasonableness of the chosen cost of capital. In this respect the financeability test is a 'sanity check' on the cost of capital.
196. Even if the funds flow position does not look adequate, the Commission should consider a different pattern of prices, which are NPV-neutral before reaching the conclusion that the cost of capital has been set at the wrong level.

⁵² Measures of financeability can include for example interest and interest and repayment coverage ratios and their implications for debt covenants and debt ratings.

197. This financeability test was used by OFWAT in the UK in a recent price review. However, they did resolve this through a higher cost of capital, which was not NPV neutral, and this approach has caused considerable controversy.
198. Dr Lally is concerned that a different pattern of prices would involve front-end loading of revenues, and this raises the burden on current consumers at the expense of future consumers. Dr Lally favours reducing the notional leverage level, if necessary.

Recommendation 75 Professor Franks recommends that the Commission examine the long term funds flow position of the regulated firm to see if it can finance its investment program and pay reasonable dividends, assuming reasonable gearing, as a sanity check on the allowed cost of capital. In the event of a financeability problem other mechanisms should be explored that are NPV-neutral, e.g. re-phasing prices before any adjustment is made to the cost of capital.

Recommendation 76 Dr Lally favours a reduction in the notional leverage level to resolve any financeability concerns, because significant re-phasing of prices affects the relative burden on the various cohorts of consumers over the life of the assets.

References

Alexander, I., Mayer, C., Weeds, H. (1996), "Regulatory Structure and Risk and Infrastructure Firms: An International Comparison", *Policy Research Working Paper Series* 1698, World Bank.

Almeida, H., Phillipon, T. (2007, forthcoming), "The Risk-Adjusted Cost of Financial Distress", *Journal of Finance*.

The Bank of England. (2008), *Quarterly Bulletin* Q3.

Blanco, R., Brennan, S., Marsh I. W. (2005), "An Empirical Analysis of the Dynamic Relation between Investment-Grade Bonds and Credit Default Swaps", *Journal of Finance* 60(5), 2255-2281.

Blume, M. (1971), "On the Assessment of Risk", *Journal of Finance* 26(1), 1-10.

Blume, M. (1975), "Betas and Their Regression Tendencies", *Journal of Finance* 30(3), 785-795.

Boyle, G., Evans, L., Guthrie, G. (2006), "Estimating the WACC in a Regulatory Setting", *ISCR working paper*.

Brealey, R., Myers, S. C., and F. Allen (2008), *Principles of Corporate Finance*, 9th ed., McGraw-Hill/Irwin: New York.

Brennan, M.J., Schwartz, E.S. (1985), "Evaluating Natural Resource Investments", *Journal of Business* 58(2), 135-157.

Bryant, P. and Eleswarapu, V. (1997), "Cross-Sectional Determinants of New Zealand Share Market Returns", *Accounting and Finance* 37, 181-205.

Buraschi, A., Jiltsov, A. (2005), "Inflation Risk Premia and the Expectations Hypothesis", *Journal of Financial Economics* 75(2), 429-490.

Cliffe, C., Marsden, A. (1992), "The Effect of Dividend Imputation on Company Financing Decisions and the Cost of Capital in New Zealand", *Pacific Accounting Review* 4, 1-30.

Cornell, B. (1999), *The Equity Risk Premium*, John Wiley & Sons: New York.

Dimson, E., Marsh, P., Staunton, M. (2002), *Triumph of the Optimists: 101 Years of Global Investment Returns*, Princeton University Press: New Jersey.

- Dimson, E., Marsh, P., Staunton, M. (2003), "Global Evidence on the Equity Risk Premium," *Journal of Applied Corporate Finance* 15(4), 27-38.
- Dimson, E., Marsh, P., Staunton, M. (2008), *Global Investment Returns Yearbook*, London Business School and ABN AMRO.
- Evans, M. (1998), "Real Rates, Expected Inflation and the Inflation Risk Premium," *Journal of Finance* 53(1), 187-218..
- Fama, E., French, K. (1996), "The CAPM is Wanted, Dead or Alive", *Journal of Finance* 51(5), 1947-1958.
- Fama, E., French, K. (2004), "The CAPM: Theory and Evidence", *Journal of Economic Perspectives* 18(3), 25-46.
- Froot, K., Perold, A. and Stein, J. (1992), "Shareholder Trading Practices and Corporate Investment Horizons", *Journal of Applied Corporate Finance* 5(2), 42-58.
- Graham, J. R. (2000), "How Big Are the Tax Benefits of Debt?", *Journal of Finance* 55(5), 1901-1941.
- Handa, P., Kothari, S. and Wasley, C. (1989), "The Relation Between the Return Interval and Betas: Implications for the Size Effect", *Journal of Financial Economics* 23(1), 79-100.
- Hausman, J., Myers, S. (2002) "Regulating the United States Railroads: The Effects of Sunk Costs and Asymmetric Risk", *Journal of Regulatory Economics* 22(3), 287-310.
- Jensen, M. C. (1986), "Agency Costs of Free Cash Flow, Corporate Finance and Takeovers", *American Economic Review* 76(2), 323-329.
- Lally, M. (1992), "The CAPM under Dividend Imputation", *Pacific Accounting Review* 4, 31-44.
- Lally, M. (1998a), "Correcting Betas for Changes in Firm and Market Leverage", *Pacific Accounting Review* 10, 98-115.
- Lally, M. (1998b), "An Examination of Blume and Vasicek Betas", *The Financial Review* 33(3), 183-198.
- Lauterpacht, E., Greenwood, C. J. (1995), "United States--United Kingdom Arbitration Concerning Heathrow Airport User Charges", *International Law Reports* 101.
- Levhari, D. and Levy, H. (1977), "The Capital Asset Pricing Model and the Investment Horizon", *The Review of Economics and Statistics* 59(1), 92-104.

- Lintner, J. (1965), “The Valuation of Risky Assets and the Selection of Investments in Stock Portfolios and Capital Budgets”, *Review of Economics and Statistics* 47(1), 13–37.
- Merton, R. (1980), “On Estimating the Expected Return on the Market”, *Journal of Financial Economics* 8(4), 323-361.
- Miller, M. H. (1977), “Debt and Taxes”, *Journal of Finance* 32(2), 261-275.
- Morningstar (2008), *Stocks, Bonds, Bills and Inflation, 2007 Yearbook*, Valuation Edition.
- Mossin, J. (1966), “Equilibrium in a Capital Asset Market”, *Econometrica* 34(4), 768-783.
- Naik, V., Trinh, M., Balakrishnan, S. and Sen, S. (2003) ‘Hedging Debt with Equity’, *Lehman Brothers Fixed Income Quantitative Credit Research*.
- NERA (2008), *Cost of Capital for PRO9 Final Report for Water UK*, available at <http://www.water.org.uk/home/news/archive/price-review-2009/cost-of-capital-report--30-06-2008>
- New Zealand Commerce Commission (2005), *Draft Guidelines: The Commerce Commission’s Approach to Estimating the Cost of Capital*, available at <http://www.comcom.govt.nz/Publications/draftguidelines.aspx>
- Officer, R. (1994), “The Cost of Capital of a Company under an Imputation Tax System”, *Accounting and Finance* 34, 1-17.
- Schaefer, S. M., Strebulaev, I. A. (forthcoming), “Structural Models of Credit Risk are Useful: Evidence from Hedge Ratios on Corporate Bonds”, *Journal of Financial Economics*.
- Sharpe, W. (1964), “Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk”, *Journal of Finance* 19(3), 425-442.
- Siegel, J. (1992), “The Equity Premium: Stock and Bond Returns Since 1802”, *Financial Analysts Journal* Jan-Feb, 28-38.
- Solnik, B. (1974), “An Equilibrium Model of the International Capital Market”, *Journal of Economic Theory* 8(4), 500-524.
- Stulz, R. (1995), “The Cost of Capital in Internationally Integrated Markets: The Case of Nestle”, *European Financial Management* 1(1), 11-22.
- Vasicek, O. (1973), “A Note on Using Cross-Sectional Information in Bayesian Estimation of Security Betas”, *Journal of Finance* 28(5), 1233-1239.

Welch, I. (2000), “Views of Financial Economists on the Equity Premium and Other Issues”, *Journal of Business* 73(4), 501-537.