Draft Guidelines

The Commerce Commission's Approach to Estimating the Cost of Capital

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Introduction

The Role of the Commerce Commission

1. The Commerce Commission (the Commission) is an independent, quasi-judicial body with responsibility for enforcement and regulatory control under a number of Acts.

2. The Commission considers that its overriding purpose is to promote dynamic and responsive markets so that New Zealanders benefit from competitive prices, better quality, and greater choice. It does this by:

   - promoting sustained competition;
   - promoting fair business practices; and
   - providing sound economic regulation.

3. This purpose definition represents the Commission's summarised view of its various statutory responsibilities. Each statute has its own purpose statement or statements. The Commission has interpreted the specific purpose of each piece of legislation or part, to arrive at this overriding purpose.

4. In fulfilling its purpose, the Commission's activities cover enforcement (investigations, litigation, and the provision of information to the public) and regulatory control (adjudication and reports to Ministers).

5. This document relates to the Commission's regulatory control activities under Parts IV, 4A and V of the Commerce Act 1986; the Dairy Industry Restructuring Act 2001 and the Telecommunications Act 2001.

Key Statutory Provisions

6. Estimating firms' cost of capital is an important issue in the Commission's regulatory responsibilities. The Commission's regulatory responsibilities are governed by a range of different statutory provisions. The key provisions are:

   - *Parts IV and V of the Commerce Act 1986.* The control provisions as detailed in Part IV of the Commerce Act provide for the imposition of control over the supply of specified goods and services by Order in Council. In assessing whether to recommend that control may and should be imposed, and in setting control parameters under Part V, the Commission is likely to have regard to firms' cost of capital.
   - *Part 4A of the Commerce Act 1986*. Subpart 1 of Part 4A provides for the Commission to implement a targeted control regime for large electricity lines businesses. It requires the Commission to set thresholds that act as a screening mechanism to identify lines businesses whose performance might warrant further examination through a post-breach inquiry, and, if required, control by the Commission. The cost of capital is relevant to the analysis of

returns for post-breach inquiries, and for control under Part V. It may also be used to assist with setting future thresholds.

- *Subpart 3 of Part 4A* provides for the Commission to require large electricity line owners and distributors to disclose information concerning their businesses. It also requires the Commission to publish a summary and analysis of the publicly disclosed information. The cost of capital is likely to be used as a benchmark for assessing returns in the Commission's analysis.
- *Part V of the Commerce Act 1986.* For Part V control of the gas pipeline activities (sections 70 to 73), the cost of capital will be used to assist with the calculation of authorised prices and/or revenues.
- *Dairy Industry Restructuring Act 2001*. Regulation 9(2) of the Raw Milk Regulations requires the Commission to set a discount rate for calculating the annualised share value if Fonterra does not use a cost of capital rate in calculating the price of a co-operative share. The Act also provides for the Commission to consider applications from parties in dispute with Fonterra in relation to the supply and pricing of raw milk.
- *Telecommunications Act 2001*. The Commission's three principal functions under the Telecommunications Act are to resolve access disputes between carriers, oversee telecommunications service obligations, and monitor the regulatory regime and recommend to the Minister of Communications changes to the list of regulated services. The cost of capital may be a relevant consideration in relation to these responsibilities.

Purpose of the Draft Guidelines

7. The purpose of these Draft Guidelines is to help parties understand the Commission's present approach to estimating the cost of capital in performing its regulatory responsibilities, and to seek the views of interested parties on the various elements of the methodology it currently uses.

8. This paper represents the Commission's preliminary views. Following industry consultation on the Draft Guidelines, the Commission intends to issue Final Guidelines on its approach to estimating the cost of capital, which it will apply across all of its various regulatory functions.

9. The final Guidelines will outline a consistent framework employed by the Commission in estimating the cost of capital. In applying these Guidelines, the Commission will use them as a starting point, and adapt them when necessary to accommodate variations in industry- and firm-specific circumstances.

10. The final Guidelines will not necessarily cover every issue that might arise under the various regulatory functions of the Commission and are not intended to be a substitute for legal advice. Parties involved in matters before the Commission are therefore urged to consult their legal advisors.

The Cost of Capital Defined

11. The appropriate cost of capital of an investment is the opportunity cost of the funds in the market, i.e., the expected rate of return an investor would seek to achieve in the market from investing in assets with a similar risk profile. The expected return on an investment must at least cover the cost of capital in order to attract the required investment funds. The cost of capital is thus a critical parameter in business valuation, investment appraisal, and in regulatory settings.

12. In the context of these Guidelines, capital refers to the financial resources that must be committed to a firm or a project with a delayed payback. There are two main forms of capital that may be relevant when estimating the cost of capital of a firm:

    - *Debt capital*. Firms take on debt by contracting bank loans or issuing bonds. In both cases, the firm promises to make repayments over the period that the debt is outstanding until it matures, at which point the original sum borrowed must be repaid in full.
    - *Equity capital*. Firms issue shares, representing a claim on the value of the firm after any existing debt has been repaid. Shareholders receive as a return both dividends, and benefit from increases in the value of shares.

13. Both types of capital are remunerated once operating costs have been paid, i.e. out of 'earnings before interest and tax', EBIT. The remaining claimants on EBIT are, in order of claiming rights, the providers of debt capital, the Government (in terms of taxes), and finally, the providers of equity capital.

14. To finance investments, firms generally raise funds from both equity investors and lenders. These two groups of investors expect to make an appropriate return on their investments. The cost of debt capital is the return lenders expect to make by holding debt in a firm, and includes a premium for the risk of default. It measures the cost to the firm of borrowing funds. The cost of equity capital is the expected rate of return investors require on an equity investment in a firm to compensate them for the systematic risk they bear.[1]

15. The overall cost of capital of a firm, whose capital base is made up of both equity and debt, is typically measured by the weighted average of the cost of equity and the cost of debt capital. This is referred to as the 'weighted average cost of capital' (WACC).

16. The specific meaning of the cost of capital depends on the context. In some cases a project or firm may be financed entirely by debt, or entirely by equity, in which case the cost of capital would be the cost of debt, and cost of equity, respectively.

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[1] Systematic risk is market risk. It is not unique to the firm and cannot be eliminated by holding a fully diversified portfolio. See the sections on the Cost of Equity (p.4), and on Beta (p.19), for more details.

The Commission's Approach to Estimating the Cost of Capital

Introduction

17. To date, the Commission has taken the overall cost of capital of a firm to be its WACC. The Commission has used the same approach for calculating the WACC across its regulatory responsibilities, adapted as necessary to the particular circumstances under consideration. The Commission has also taken into account new research and submissions, and adjusted its approach accordingly, over time.

Overview of the Approach

18. Firms are typically funded by a combination of debt and equity. A firm's cost of capital therefore represents the weighted average cost of equity and debt, with the latter net of the corporate tax deduction. The WACC is calculated using the following equation:

$$WACC = k_e(1-L) + k_d(1-T_c)L \qquad (1)$$

where k_e is the cost of equity capital, k_d is the cost of debt, T_c is the corporate tax rate and L is the financial leverage ratio (i.e. debt to total capital).

Cost of Debt

19. The cost of debt, k_d, measures the cost to the firm of borrowing funds. It represents the interest rate required by investors to hold the firm's debt, given the risks they bear. It can in some cases be observed directly as the yield on debt issued by a company (e.g., a bond issue with a specified return), or the cost of banks' lending to borrowers. However, typically it is estimated as the sum of the risk-free rate (R_f) and a premium (p) to reflect marketability and risk of default. Thus, the cost of debt is defined as:

$$k_d = R_f + p \qquad (2)$$

Cost of Equity

20. The cost of equity is the expected rate of return required by investors on equity that compensates them for the risk they bear. It represents the opportunity cost of the funds they have invested. While the cost of debt can be observed directly as the yield on debt issued by a firm, the cost of equity cannot, and must be estimated. A number of methods are available for estimating the cost of equity. The Capital Asset Pricing Model (CAPM) is the most commonly applied, due, in part, to its clear theoretical foundations, its intuitive appeal and relative ease of application.[2]

[2] In a study covering 392 CFOs, Graham and Harvey (2001) found that the CAPM was by far the most frequently used method to estimate the cost of equity capital, with 74% of CFOs always or almost always using it.

21. The CAPM is a single factor model that postulates a linear relationship between the expected return on an asset and the systematic risk associated with holding that asset (measured by its 'beta'). In line with portfolio theory, the CAPM does not compensate equity investors for bearing unsystematic (i.e. company-specific) risks, which are eliminated through diversification of investment portfolios (the assumptions of the CAPM imply that investors hold a combination of the market portfolio and a riskless asset). Thus, in the model risk-averse investors require adequate compensation only for the systematic risks they bear. The model captures the well-know risk-return trade-off, which posits that the greater an asset's systematic risk, the greater the investor's required expected return. The model expresses expected returns in terms of a premium above the risk-free rate that is related to the sensitivity of the asset's return to the return on the market portfolio. Specifically, the sensitivity of the asset's return to the return on the market portfolio, the equity beta, reflects the amount of systematic risk that applies to a particular asset.

22. The original CAPM model, now commonly used for estimating the expected cost of equity (k_e), was developed by Sharpe (1964) and Lintner (1965) and is expressed by the following formula:

$$k_e = R_f + \beta_e MRP \qquad (3)$$

where β_e = equity beta
MRP = market risk premium ($k_m - R_f$)
k_m = expected rate of return on the market portfolio.

23. The classical CAPM does not take personal taxation incurred by investors explicitly into account, and therefore does not adjust for the effect of any imputation credits attached to dividends. Building on the work of Brennan (1970), Lally (1992) and Cliffe and Marsden (1992) developed a version of the CAPM (the 'Brennan-Lally model') that explicitly takes account of personal tax rates that differ across both investors and sources of income. This model may be suitable for the New Zealand tax regime.

24. In estimating the cost of equity, the Commission relies on a simplified version of the Brennan-Lally model. The model assumes that: dividends are fully imputed and investors have the ability to fully utilise them; the average investor faces a marginal tax rate on interest (currently of 33%); and that capital gains are not taxed. The model also assumes that domestic equity markets are closed to foreign investors. The simplified Brennan-Lally model for estimating the cost of equity is expressed as follows:

$$k_e = R_f(1 - T_I) + \beta_e MRP \qquad (4)$$

where T_I is the average (across equity investors) of their marginal tax rates on ordinary income, and the definition of the MRP consistent with the simplified Brennan-Lally model is given by the following equation:

$$MRP = k_m - R_f(1 - T_I) \quad (5)$$

25. The WACC formula – equation (1) – and of the cost of debt – equation (2) – are uncontroversial, and accord with generally accepted practice.

26. However, there are alternative specifications of the classical CAPM – equation (3) – including: the Brennan-Lally CAPM, equation (4); the Officer (1994) model; and models that recognise international investment opportunities.[3] The Commission's view is that the simplified Brennan-Lally model better reflects the personal tax regime operating in New Zealand than the classical CAPM (which assumes that all forms of personal income are equally taxed), or the Officer version (which assumes that interest and capital gains are equally taxed).[4]

27. The Commission notes that the simplified Brennan-Lally CAPM model assumes that national equity markets are completely closed whilst the international model assumes that they are completely integrated. The actual situation is likely to be somewhere between these two extremes, although some evidence exists to suggest investors exhibit home bias.[5] The Commission also considers that the international CAPM would be difficult to apply in practice. Estimates of the required parameters are less reliable than their domestic counterparts, and there is little consensus on their values.

28. As a general point on the CAPM, the Commission acknowledges that the model relies on a number of simplifying assumptions that violate real world conditions.[6] A large body of empirical work has rejected the CAPM on the basis that the actual performance of investment portfolios fail to match the theoretical predictions of the model. For instance, Fama and French (2004) argue that the CAPM's empirical

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[3] See for example, Solnik (1974).

[4] The Commission adopted a modified version of the simplified Brennan-Lally model in estimating Fonterra's discount rate. The Brennan-Lally model assumes that dividends are fully imputed and capital gains are tax free. In Fonterra's case this is not true. Its dividends (part of the total payout to farmers) are tax deductible at the corporate level (i.e. they are treated as an expense) and taxable at the personal level (i.e. they are treated as income). For further detail, see the Commerce Commission's website under the section *Dairy Industry Restructuring Act 2001*. A different CAPM model or modified Brennan-Lally model may be preferable where tax credits cannot be utilised by non taxpaying shareholders.

[5] See Cooper and Kaplanis (1994).

[6] The classical CAPM framework assumes that: investors are risk-averse and only care about the mean and variance of their portfolio's returns; markets are frictionless; unlimited lending and borrowing is possible; and that investors have homogeneous expectations (e.g., see Grinblatt and Titman, 2002, p.151). Also, as already noted, the simplified Brennan-Lally CAPM assumes international equity markets are completely fragmented.

inability to explain historical average returns probably invalidates its use in applications.[7]

29. However, in his famous critique of empirical tests of the CAPM, Roll (1977) argued that the unobservability of the true market portfolio (upon which the CAPM relies), which contains all assets (both marketable and non-marketable)[8], implies that empirical tests of the CAPM must rely on proxies for the market portfolio (e.g. stock indices). Therefore, these tests only really reject the mean-variance efficiency of the proxy; the CAPM itself might not be rejected if the true market portfolio were able to be used.

30. Wright et al (2003) surveyed a number of alternative asset pricing methodologies, but despite all its potential shortcomings, found no clear successor to the CAPM for the practical estimation of firms' cost of capital.

31. One criticism of relying entirely on the CAPM when determining firms' cost of capital is that the model does not deal with many of the risks that investors potentially take into account when setting hurdle rates, and therefore may not produce a rate of return that accurately reflects investors' true or perceived cost of equity.[9]

32. Empirical evidence suggests investors' hurdle rates may exceed the WACC, which is estimated using the CAPM so only reflects compensation for systematic risk.[10] One possible explanation for this observation is that investors take into consideration both systematic *and* unsystematic risks when selecting projects, perhaps because perfect diversification may be too costly to achieve.[11] Therefore, one viewpoint is that when estimating firms' cost of capital (i.e. a fair rate of return that reflects all relevant risks and costs), regulators should also take account of unsystematic risks.

33. Asset stranding, suboptimal investment timing, or financing constraints, are all examples of events or factors that raise the expected cost of a project. These events or factors have uncertainty attached to them, so an element of risk (dispersion) surrounds expectations of associated costs. This risk may be systematic,

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[7] In this article, Fama and French survey a number of studies that find that the cost of equity estimated using the CAPM tends to be too high (relative to historical averaged returns) for high betas and vice-versa, and that returns are not entirely explained by market betas, which is a key prediction of the CAPM.

[8] Examples of assets, both traded and non-traded, that should be contained in the true market portfolio include, for example, human capital, real estate, stocks and options, etc.

[9] A *hurdle rate* is defined as the minimum rate of return required on a project before it is accepted by investors. Another way to view a project's hurdle rate is its *internal rate of return* (the implied rate of return that sets the expected net present value of the project's cashflows to zero), when *all* costs relevant to the project (both direct and indirect) are taken into consideration.

[10] See Dixit and Pindyck (1994: p.7); Poterba and Summers (1995).

[11] As noted by Malkeil and Xu (2002), only the undiversified part of a security's unsystematic risk (i.e., the amount of unsystematic risk that is not eliminated (and remains with investors) if diversification opportunities are limited) matters, not necessarily the security's total unsystematic risk..

unsystematic, or partially both. Where the relevant risk is systematic in nature, the CAPM ensures that investors are appropriately compensated. However, where the relevant risk is unsystematic, the CAPM does not offer an adequate treatment so the Commission must determine whether it is appropriate to compensate firms for bearing those risks, and if so, identify an appropriate method by which to quantify and provide appropriate compensation.

34. Making an upward adjustment to firms' WACCs, to account for unsystematic risks, is an approach often advocated by regulated firms. However, the Commission considers that making such adjustments may be arbitrary and ad hoc. Arguments for an increment to the WACC to compensate for the loss of investment flexibility and other unsystematic risks are discussed later in the section 'Allowances for Other Issues' (p. 27).

Estimation of Model Parameters

Risk-Free Rate

35. The risk-free rate is used in calculating both the cost of debt and the cost of equity. The risk-free rate is the interest rate that an investor would require to invest in a riskless asset. The risk-free rate is proxied by the yield to maturity on government bonds.

36. The major issues in determining the risk-free rate are the maturity of government bonds to use and the period of averaging of observed returns. These issues are discussed below.

Appropriate Maturity and the CAPM

37. The CAPM is a single period model that provides no guidance as to the appropriate maturity of the risk-free rate. Regulators have typically chosen a maturity that matches:

- the technical or economic life of the assets used in providing the regulated service, on the basis that this reflects the planning horizon of investors in those assets; or
- the duration of the regulator's determination or the price-setting period ('the regulatory period'), given that the risk-free rate will be adjusted in any subsequent reset.[12]

38. The maturity of the risk-free rate could also be set such that it matches:

- the duration of debt actually held by the regulated firm; or
- the bond term used to measure the market risk premium.

[12] Where the Commission is assessing the behaviour of an unregulated firm, the regulatory period is assessed by the Commission based on the observed frequency of price modifications.

39. Under price control, and in assessing whether or not to recommend control, regulatory decisions should attempt to ensure that the discounted present value of expected future cash flows are equal to the initial investment. The Commission terms this the *NPV = 0 principle*. This regulatory principle essentially reflects the Commission's overriding goal to ensure that firms earn a reasonable return (i.e. their cost of capital), and recover the initial cost of investment, but no more.

40. Lally (2004a) shows that to meet the NPV = 0 test the term of the risk-free rate must match the regulatory period. This result holds even in the presence of cost and volume risks, and risks arising from different asset valuation methodologies.

41. Lally (2004a) shows that whenever the yield curve is upward sloping, and the term of the risk-free rate used to set prices exceeds the length of the regulatory period, the firm will be overcompensated (i.e. the NPV of the firm's cash flows will exceed zero). The intuition behind this result is as follows. An upward sloping yield curve implies that current long-term rates have a premium over prevailing short-term rates. This premium could either reflect the illiquidity of long-term investment (the Liquidity Premium Hypothesis), or expectations that short-term rates will increase in the future (the Expectations Hypothesis). In both instances, the premium is required to induce investors to commit to holding long-term investments over short-term investments.

42. By adopting long-term rates in excess of the regulatory period when estimating the cost of equity, the Commission would effectively allow firms to receive this premium to cover risks or expectations beyond the regulatory period, even though they do not face those risks, or need to form expectations of future interest rates, due to the resetting of output prices. This would result in over-compensation.

43. In contrast, if the term of the risk-free rate were matched to the regulatory period, then the cost of equity would better reflect the risks and opportunity cost of invested funds over the regulatory period, and not some longer time horizon.

44. This analytical point can be illustrated using a highly stylised example adapted from Lally (2004b: pp. 27-8): Assume a regulator sets a firm's output prices every year, and the duration of that firm's assets is two years. The one-year risk-free rate is currently 5%, and, in line with the Expectations Hypothesis, the two-year risk-free rate is 7.5%, commensurate with expectations that interest rates will rise to 10% in two years.[13] Furthermore, assume expectations are correct and the risk-free rate rises to 10% at the end of the first year, for all terms to maturity. The regulator could either set prices using a risk-free rate that matches the regulatory cycle, or using a rate that matches asset lives.

45. In this simplified example, if the first option were taken (i.e., the R_f term matches the regulatory period), then a rate of 5% would be used to set prices in the first

[13] By the Expectations Hypothesis, the two year rate is calculated by taking the average of the current one-year risk-free rate (5%) and the expected one-year rate in a year's time (10%).

period, and a rate of 10% for the second period. If the second option were taken (i.e., the R_f term matches the asset's life), then a rate of 7.5% would be used to set prices in the first period, and a rate of 10% thereafter.

46. The second option would lead to double-dipping in the sense that the firm would be rewarded both for high interest rates when they occur, and also in anticipation of them. If instead, one-year rates were expected to fall in the second period (i.e., a downward-sloping yield curve, by the Expectations Hypothesis), the firm would be under-compensated; the firm would be penalised in the first period in anticipation of low future interest rates, even though expectations would not need to be formed beyond the regulatory period due to the resetting of prices. Hence, using long-term rates, determined via *expectations* about future movements in short-term rates, to set prices over short regulatory periods may either over- or under-compensate firms.

47. Suppose instead that in the example, the two-year risk-free rate exceeds the one-year risk-free rate due to a *liquidity premium,* rather than to expectations over future interest rates. That is, an upward-sloping yield curve may be explained by the Liquidity Premium Hypothesis, which implies that investors require compensation via a premium for the illiquidity of long-term investments.[14] In this scenario also, the firm would be over-compensated if the two-year rate were used to set prices; the firm would be rewarded for bearing interest risk for a period beyond the price-setting period, when it would not face that risk at the end of the regulatory period.

48. As a consequence of the premium in the term structure of interest rates (either due to liquidity preferences, or expectations about future yields), the use of long-term rates would lead to higher prices than would otherwise be the case, and to a violation of the NPV = 0 principle.

49. The Commission's view is that the term of the risk-free rate should match the regulatory period on the basis that this ensures that the NPV of future cash flows matches the initial investment, and that charges should reflect expected costs and risks over the term for which prices are fixed, but not be affected by the expectations of costs and risks beyond that point.

50. The principal argument against the Commission's approach is that the term should be based on the life of firms' assets, because the term of the firm's debt matches asset lives in order to minimise re-contracting risk on this debt. The Commission accepts that firms may wish to raise long-term debt capital to minimise the costs of financing long-lived assets and to manage refinancing risk. However, it notes that although firms may adopt long-term financing strategies, that does not necessarily mean they choose to be exposed to long-maturity interest rates. Indeed, many firms use hedging arrangements to obtain a preferred (shorter-term) interest rate

[14] This liquidity premium essentially compensates investors for bearing interest rate risk. For example, by committing funds to an investment in a two-year bond today, the investor forgoes the ability to speculate on a possible increase in one-year bond yields in a year's time, or any other profitable investments, using those funds.

exposure.[15] The Commission notes that in principle, the costs of raising debt or entering into hedging arrangements should be averaged and reflected in the debt margin or in the firm's cash flows (but not both).

51. Another argument for a regulator using a long-term bond maturity is that a short-term rate introduces uncertainty into the business.[16] However, if firms recognise, among other things, prevailing interest rates at the time they reset prices, their revenues will reflect these shorter-term interest rates. When the Commission resets prices at each regulatory period, that is exactly what is occurring. So, the use of the shorter-term rate better matches the cost of capital to the firm's revenues, and therefore does not increase interest rate risk.

52. Another suggestion is that while the use of a long-term bond maturity would result in over- or under-recovery of returns if the price setting period were short, the over- or under-recovery would be likely to balance out over time.[17] However, such balancing would not occur if interest rates were expected to continue to rise or to remain constant after increasing. Further, while the over- and under-recoveries might balance out over time, they might not do so in present value terms.

53. A further option that could be envisaged would be to use the actual or targeted average maturity of debt held by the regulated firm. Firms generally hold a number of different debt instruments with staggered maturity dates. This is so because firms typically trade off a number of risks and costs when choosing their debt structures, and also undertake projects at different dates.

54. Under this option, the time horizon used to estimate both the cost of equity and cost of debt would be the average maturity of debt held by the regulated firm. Given that regulation is one of many factors that firms consider when making financing decisions, it is unlikely that adopting this approach would significantly alter the incentives of the firm with respect to their borrowing strategy and capital structure. However, insofar as the maturity of debt held by the regulated firm exceeds the regulatory period, this approach would not satisfy the NPV = 0 principle.

55. In respect of certain industries, this option may in practice be quite similar to matching the maturity of the risk-free rate to the economic life of assets or the investment horizon of the firm, as firms would typically seek to keep their debt maturity broadly in line with the life of their assets.

56. From an operational perspective, this approach may potentially also raise practical computational difficulties as firms typically hold a large number of debt instruments of varying maturities, and use instruments that alter their effective interest rate exposure. It may also be difficult to identify precisely the average debt maturity of a particular activity of a multi-product firm.

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[15] See Bowman (2004: p 30).
[16] See Boyle et al (2004: p 13).
[17] See Boyle et al (2004: p 12).

57. The argument that the maturity of the risk-free rate should match the bond term used to measure the MRP is discussed below in the section on the MRP.

Average Rates

58. As the yield on the appropriately dated government bonds change over time, the risk-free rate has to be derived as some kind of average of the varying yields. For example, the risk-free rate (derived from the appropriate government bond maturity) could be averaged over one day or a larger number of days prior to the regulatory period. The choice reflects a trade-off between the timeliness of the data and the smoothing of abnormal effects. The Commission's practice has been that averaging should generally be conducted over at least a one month period, but the appropriate period will depend upon the specific circumstances of each case.

59. Three averaging techniques may be employed: median, arithmetic, and geometric. Arithmetic averaging is more suited to matching the firm's allowed revenues to its borrowing costs, and is therefore used by the Commission.[18]

Market Risk Premium

60. The MRP measures the additional expected return over and above the risk-free rate required to compensate investors for holding the market portfolio. It therefore represents the premium investors can expect to earn for bearing only systematic (common) risk. As such, the MRP is not a firm-specific parameter, but rather, is common to all assets in the economy. There is continuing debate over the appropriate methodology to use to estimate the MRP, and over its size.

61. In applying the CAPM, which is a forward-looking model, the Commission needs to estimate the expected MRP over the relevant future time horizon. Ideally, any forward-looking estimate of the MRP should closely reflect investors' expectations.

The Different Approaches to Estimate the MRP

62. The various approaches that can be used to estimate the MRP can be classified into two broad categories: ex post or historical methods; and ex ante methods.

63. The most common ex post approach is to use historical market returns and risk-free rates, of a long maturity generally, to calculate an ex post MRP, as done by Dimson et al (2002, 2005), Ibbotson (2001), and Siegel (1992).[19] Another ex post method was developed by Merton (1980), whereby the MRP is estimated by applying a historically estimated reward to risk ratio to an estimated volatility of market returns.

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[18] See Lally (2002: pp. 17-19) for a more detailed discussion.

[19] The results derived from this type of approach are sensitive to the averaging method used, i.e., arithmetic or geometric. By and large, there is a wide consensus amongst academics in favour of arithmetic averaging.

64. Ex ante approaches such as those presented by Cornell (1999), and Claus and Thomas (2001), estimate the MRP as the difference between current risk-free rates and the implied rate of return that equates current stock market valuations (a proxy for the value of the market portfolio) with the present value of prevailing forecasts of future dividends. Survey evidence (of academics and practitioners) is another ex ante approach for estimating the MRP.

65. Ex post or historical methods provide the benefit of being relatively objective and easy to interpret. However, such approaches have a number of limitations. To provide unbiased estimates of future MRP, it is implicitly assumed that the risk-aversion of investors remains constant through time. However, this assumption may not hold in practice since, for example, business cycles may cause investors' risk preferences to change over time. As investors become more/less risk-averse, the rate of return required to induce them to hold the same level of systematic risk will increase/decrease.

66. Historical returns may also not necessarily be good predictors of future returns: Dimson et al (2002; 2005) argued that global equity returns have far exceeded expectations in the past century, and that the level of growth is unlikely to be reproduced. At the same time, the past century was characterised by periods of unexpectedly high and unstable levels of inflation that damaged real bond yields and led to a high ex post MRP. Thus, prospective MRP estimates based on unadjusted ex post MRPs are likely to be biased upwards (i.e., to over-predict premiums), as acknowledged by Dimson et al. (2003).

67. Furthermore, as equity markets expand (i.e., grow deeper as more firms and industries are represented), and become more globally integrated, the opportunities for investors to diversify their portfolio increase. This will tend to reduce the level of systematic risk faced by investors, and therefore, the premium they require for bearing such risk. Hence, the historical MRP may overstate future MRP.

68. It is also worth noting that the efficiency of ex post estimates relies on the quality and availability of the underlying data. Even if long historic time series on returns and interest rates were available, a period for analysis must be selected. If short time series were used, the MRP estimates are likely to be accompanied by high standard errors. Because of the inherent volatility of stock markets, relatively short periods of estimation, say a decade, may also not lead to sensible inferences as they may incorporate only "bad times", for example. If long series were used (potentially improving the precision of the MRP estimates), the possibility of including irrelevant data (e.g. series potentially containing structural breaks) increases.[20]

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[20] Structural breaks in historical time series, caused by significant shifts in political or economic conditions, major institutional change, or world events, can lead to the nonstationarity problem described by Cornell (1999: pp. 45-8). He argues that historical averages used to forecast future MRP values are only meaningful if the averaged data are drawn from the same 'population', i.e., if the historical time series is

69. Not surprisingly, the MRP estimated in this way changes over time, and is dependent on the start date and end date (and hence on the length of period chosen). For instance, Damodaran (2001: pp. 191-2) shows that estimates of historical risk premia for the US (using Ibbotson data), evaluated over three separate time intervals (1926:98; 1962:98; and 1981:98), vary significantly.

70. The use of data from foreign markets may be useful in overcoming the problems of availability and overall quality of New Zealand data. This is discussed below.

71. Ex ante methods do not involve reliance on historical data, and arguably are more relevant than ex post estimates as they draw only on currently available market information. They nevertheless have their own limitations. Implied MRP models of the sort employed by Cornell, and by Claus and Thomas, rely on the accuracy and reliability of various forecast inputs, such as the growth of future earnings. Also, these models rely on the assumption that equity markets price stocks correctly. The informational efficiency of equity markets is still a subject of considerable empirical debate in the academic literature.[21]

72. Survey evidence can be highly subjective and variable, and may as a result introduce a significant amount of noise to the estimation process.

73. Whatever methodology is used to estimate the MRP, there will always be some associated statistical uncertainty. The Commission's view is that all of the different methodologies outlined above have advantages and disadvantages, but that all help to inform the estimation of the MRP. It has therefore adopted the approach of basing MRP estimates on the various methodologies discussed, rather than preferring some approaches over others.

Foreign Country Data

74. The Commission considers that there are a number of limitations associated with basing historical MRP estimates solely on available New Zealand stock returns and interest rates data.

75. Interest rate controls and regulation of financial institutions, which prevailed in New Zealand until 1985, meant that interest rates prior to this period were not purely market-determined. Lally (2004b: p.13) argued that, absent controls, interest rates would have been higher, and historic MRP estimates lower, prior to 1985. Also, New Zealand equity markets were closed to foreign investors until liberalisation occurred in 1985. Deregulation was followed by a burgeoning of interest by foreign investors in domestic firms, which likely would have had a significant impact on stock returns and risk premia in New Zealand. Therefore, the

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stationary. 'Populations', in this context, means time intervals separated by major structural changes. Averaging data across populations will lead to nonsensical forecasts.

[21] See Ross et al (1996: pp. 343-53) for a survey of empirical studies on the Efficient Markets Hypothesis.

removal of controls would likely have produced a significant structural shift, limiting the usability of data prior to 1985.

76. Furthermore, the New Zealand equity market is relatively young and small compared to those of many other countries. Trade is characteristically thin, and stock indices represent weakly diversified investment portfolios, given the small number of represented firms. In comparison, US equity markets are significantly more established, well-diversified, and deeply traded. Damodaran (1999a) argues that historical data on thinly traded equity markets (such as New Zealand's) yields unreliable estimates of the MRP, since such markets represent a small proportion of the overall economy, tend to be dominated by a few large firms and are generally poorly diversified across industries. They also typically fail to provide long enough time series to minimise estimation errors.

77. Given the limitations of available New Zealand data, the Commission has previously considered comparator MRP estimates from the US, and from an average across 15 other developed countries (i.e., a 'world sample'),[22] when estimating the New Zealand MRP. In such instances, the Commission adjusted the overseas estimates to ensure consistency with the simplified Brennan-Lally MRP specification in equation (5).[23]

78. However, Dimson et al (2002; 2005), who estimated (pre-tax) MRP for 16 developed nations, revealed that cross-country variations in MRP estimates can be significant, as illustrated in the table below.

Table 1: Cross-country variations of Estimates of the Market Risk Premium

Switzerland	Belgium	UK	US	Australia	Japan
3.1%	4.2%	5.2%	6.6%	7.8%	9.7%

Note: The Table lists estimates of the MRP consistent with the classical CPAM equation of the MRP.
Source: Dimson et al (2005: p.39)

79. These variations may be driven by country-specific factors, including: market volatility; domestic business cycles and inflation; economic growth; political stability; the characteristics of equity markets (e.g. depth and diversity of firms); and other factors. Although it may be argued that giving consideration to foreign MRP or world estimates introduces unwanted country-specific noise to the process of selecting an appropriate value for the domestic MRP, on balance, the Commission considers that when selecting an appropriate value for the New Zealand MRP, it is useful to consider overseas MRP estimates as they help overcome the limitations associated with New Zealand data.

[22] See Dimson et al (2002: Chapter 12).
[23] See Lally (2004b: pp. 13-5).

Commission's Estimates

80. Lally (2004b: pp.10-9) reviewed estimates of the MRP based on the ex post and ex ante methodologies discussed above, for New Zealand, the US, and a sample of 15 other developed countries. His results are reproduced in Table 2.

Table 2: Estimates of the Market Risk Premium

	New Zealand	United States	World Sample
Siegel Methodology	5.9% (2.8%)	7.3% (2.0%)	6.4% (2.3%)
Cornell Methodology	6.4%	6.3%	
Ibbotson Methodology	7.3% (2.7%)	8.7% (2.0%)	8.4% (2.2%)
Survey Results	8.0%	5.5%	
Merton Methodology	8.3%		
Median	7.3%	6.8%	7.4%

Notes: Table adapted from Lally (2004b: p.16). Values in parentheses represent the standard deviations of estimates.

81. The Commission's conclusion, based on Lally's analysis, is that the appropriate point estimate for the MRP is currently 7%, with a standard deviation of 1.5%. The range, taking one standard deviation either side of the point estimate, is therefore 5.5% – 8.5%.

Consistency and the Risk-Free Rate in the MRP

82. The risk-free rate appears in two places in the CAPM formula. The first R_f appears in the first term of the equation, while the second R_f term is a component of the MRP. In determining an appropriate MRP, consideration needs to be given as to whether the maturity of the second R_f term should be consistent with the first R_f term in the CAPM equation, or whether it should be consistent with the investor horizon implicit in the k_m. For ease of reference, the cost of equity equation consistent with the Brennan-Lally CAPM model may be expanded as follows:

$$k_e = R_f(1-T_I) + [k_m - R_f(1-T_I)]\beta_e \qquad (6)$$

83. The CAPM is a single period model with an unspecified investor horizon, which is often assumed to be five to ten years. Strictly speaking, the model is not applicable to multi-period analysis, nor to a single period differing from investors' investment

horizons. The model says nothing about the adjustments that should be made when considering periods that do not equate to the investment horizon.

84. The Commission's view is that the first R_f should match the regulatory period, which is generally in the order of one to five years. The matching of the first R_f to the regulatory period ensures that the NPV of the future cash flows matches the initial investment.

85. If the first R_f is chosen on the basis of the regulatory period, and this period is less than five years, the issue arises as to whether the two R_f terms should be consistent, or the term of the second R_f should match the investor horizon.

86. The Commission is faced with the following options:

- the term of the second R_f could be set to match the term of the first R_f (achieving consistency in the risk-free rates), and therefore will vary with the regulatory situation; or
- the term of the second R_f should not be altered, i.e., it should continue to match the generally assumed term for the investor horizon in the CAPM (five to ten years), which is independent of the particular regulatory period.

The first approach assumes that the expected market return, k_m, is the same over different time horizons, whilst the second approach assumes that the MRP is the same over different time horizons.

87. On balance, the Commission considers that the assumption that the MRP is invariant to the time horizon in question is reasonable, and that this represents the best practical option available to address the issue of consistency. Thus, the MRP is assumed to yield approximately the same value using a ten-year or a one-year horizon for both the k_m and the R_f.

88. An advantage of the second option above, from an implementation standpoint, is that it uses the same market risk premium irrespective of the regulatory situation. Further, the historical methodologies used to estimate the MRP have generally (but not always) used a five or ten year R_f. If the first approach were adopted, and in the face of say a one or three year regulatory period, the MRP would have to be estimated using the one or three year R_f, and this would present data collection and computational difficulties. In addition, the Commission notes that estimates of the MRP derived by some approaches cannot be adjusted readily in this way. Finally, the second option minimises the adjustments that must be made to the CAPM model, changing only those aspects of the model (the first R_f) that need to be changed in order to fit the particular regulatory situation.

89. The issue of the consistency of the maturities of the risk-free rates used in the CAPM was considered in a decision concerning GasNet Australia by the Australian Competition Tribunal (Tribunal) in 2003.[24]

90. GasNet Australia submitted for approval to the Australian Competition and Consumer Commission (ACCC) an access arrangement that contained an estimate of its cost of capital based on the CAPM. GasNet Australia used a ten-year bond rate when calculating its cost of capital. The ACCC, however, did not approve the access arrangement as the maturity of the bond rate used in the first R_f term did not match the five-year regulatory period. This decision was challenged by GasNet Australia before the Tribunal, which stated that "while the CAPM permits some flexibility in the choice of the inputs required by the model, it nevertheless requires that one remain true to the mathematical logic underlying the CAPM formula. In the present case, that requires a consistent use of the value of [R_f] in both parts of the CAPM equation where it occurs so that the choice was either a five year bond rate or a ten year bond rate in both situations".[25]

91. The Commission notes that the Tribunal did not specifically discuss in its decision whether adopting a risk-free rate in the first term of the CAPM equation that is longer than the regulatory or price setting period would result in the firm over- or under-recovering its initial investment. In the GasNet Australia decision, the Tribunal noted that the only issue for the ACCC was whether GasNet Australia had used the CAPM model to produce a rate of return that was consistent with its conventional use. The Tribunal found that it was not open to the ACCC to choose a model other than the CAPM or to adapt it on the basis that it would produce a superior outcome in terms of the objective of the regulatory framework. In other words, the Tribunal did not state that GasNet Australia's approach was the only or best approach to use, only that the ACCC had no grounds not to approve it.

92. The Commission's view is that the legal framework underlying the GasNet Australia decision is distinguishable from that of the Commission's powers under the Commerce Act, Dairy Industry Restructuring Act and Telecommunications Act. Unlike the ACCC in the GasNet Australia decision, the Commission, in discharging its responsibilities under these Acts, is able to choose the methodology that it considers most appropriate for its purposes.

93. The Commission also notes that, in similar circumstances, the question of consistency between the maturity of risk-free rates used in the CAPM has not arisen in other countries. For instance, in the UK, Ofcom generally adopts a maturity of the first risk-free rate that broadly matches the regulatory period. However, when estimating the MRP, it gives weight to ex post estimates of the MRP relative to bonds of a maturity longer than the regulatory period.

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[24] Australian Competition Tribunal (2003).
[25] Australian Competition Tribunal (2003: para. 46).

94. The Commission concludes that the application of the theoretically 'pure' version of the CAPM model is not possible in all circumstances. On balance, the Commission considers that the assumption that the MRP is invariant across different time horizons is reasonable, and represents the best practical option available to address the issue of consistency.

Beta

95. Beta measures the sensitivity of an investment's return to the market return. Risk relates to the possibility that returns may deviate from expected returns. The total risk of an asset or business is made up of both systematic and unsystematic risk.

96. Unsystematic risk is specific to the asset or firm and may be eliminated by diversification. The risks associated with technology obsolescence, increasing competition, patent approval, antitrust legislation, management styles and geographic location are all examples of diversifiable risks.

97. Systematic risk is market risk, not unique to the firm. Such risk cannot be eliminated by diversification. It is related to, and dependent on, the state of the economy as a whole. The sources of systematic risk include changes in real GDP, inflation, currency movements and the long-term real interest rate. The impact of changes to real GDP dominates in terms of explaining the variation in betas across firms.

98. As systematic risk is common to all firms, this implies that when the stock market falls (e.g., because of an increase in the world price of oil), all stocks are systematically affected by the same risk, although some to a greater or lesser extent. The beta seeks to capture the exposure of a particular asset to systematic risk by measuring the sensitivity of the asset's returns to market returns.

99. By virtue of the risk-return trade-off, the greater a firm's exposure to systematic risk (i.e. the higher its beta), the higher will be the cost of any equity used to finance its operations. That is, risk-averse investors will need to be compensated for the higher risk borne.

100. As discussed previously, only systematic risk is relevant in determining a firm's cost of equity within the CAPM framework. Investors are not compensated through the CAPM for diversifiable risk since the assumptions of the model implies that they hold a combination of the market portfolio of risky assets and a riskless asset, and this eliminates diversifiable risk.

Factors Influencing Betas

101. Although systematic risks are common to all firms in the economy, company-specific characteristics influence the extent to which these risks impact on firms. Differences in betas across companies arise primarily from differences in the

sensitivity of returns to unexpected changes in real GDP. The main determinants of betas include:[26]

- *Type of business and industry*. Since beta measures the systematic risk of a firm relative to the stock market, the more sensitive an industry or business is to the state of the economy, the higher its beta and vice versa. Thus, firms involved in cyclical industries, such as construction, can be expected to have higher betas than firms operating in industries less sensitive to the state of the economic cycle, such as food retailing and manufacturing.

- *The nature of the product or service*. Firms producing products with low income or price elasticity of demand (necessities such as energy) should have lower sensitivity to unexpected changes in real GDP than firms producing products with high income elasticity of demand (luxuries), because demand for their products is less sensitive.

- *Pricing Structure.* Firms with revenues comprising both fixed and variable elements should have lower sensitivity to the state of market conditions than firms whose revenues are entirely variable. Fixed charges are an important part of the pricing structure of many infrastructure industries.

- *The nature of the customer.* There are two aspects to this: the split between private and public sector demand, and the personal/business mix.

- *Duration of contract prices with suppliers and customers.* In the presence of a positive demand shock, a firm with long-term output price contracts is unable to increase its prices upward, and this can be expected to reduce its beta. On the other hand, its inability to increase prices in response to a cost shock can be expected to increase its beta. Thus, the actual impact on beta is ambiguous.

- *Market power.* The impact of market power on betas is also ambiguous and depends principally on company and industry specific characteristics (e.g. nature of the product). A firm with market power, measured by the price elasticity of (residual) demand, might be in a better position to exploit positive real GDP shocks. As a result, its returns might be more volatile than market returns. By contrast, in the case of an adverse economy-wide shock, the firm's returns might vary to a lesser extent than the market return insofar as market power could be used by the firm to keep prices at a level that limits the adverse impact on its returns.

- *Degree of operating leverage*. Operating leverage can be defined as the proportion of fixed costs to total costs, and captures the extent to which operating income varies with changes in revenues. Operating leverage magnifies the effect of business cycles on a firm's profits (and hence beta) as firms with greater operating leverage will typically be more sensitive to fluctuations in real GDP since their profits will be more sensitive to variations in demand (and hence

[26] On the determinants of betas, see also Alexander (2004), Damodaran (1999b, 2001), Ogier et al (2004) and The Treasury (1997), among others.

variations in revenues). This is because fixed costs represent a cash outflow that must occur regardless of the level of revenue while variable costs depend on the level of activity.

- *The nature of regulation (i.e. the presence of price or rate-of-return regulation)*. Firms subject to rate-of-return regulation (with annual price resetting) can be expected to have lower sensitivity to unexpected changes in real GDP, because the regulatory process is geared towards achieving a fair rate of return. Price regulation may have a similar effect, provided prices are frequently reset. However, as the reset interval increases, the price adjustment to adverse cost shocks is increasingly delayed, and unless there is a 'pass-through' provision, this should raise the firm's beta. The length of the regulatory period is not the only factor that may impact on beta, in particular in the context of incentive regulation. The impact of the regulatory regime may be complex to assess and vary with specific circumstances.

- *Financial leverage.* Financial leverage, defined as the ratio of debt to total capital, impacts on equity betas. Direct estimates of beta (see below) are equity betas and reflect both the operational risk of a firm and its financial structure. Other things being equal, an increase in financial leverage will lead to an increase in the equity beta since a higher level of leverage implies a higher volatility of returns to shareholders. In other words, because obligated payments on debt do not vary with the level of revenues, and debt holders have a priority call on cash flows, financial leverage magnifies the systematic risk of the cashflows distributable to equity holders.

  Thus an equity beta measures total systematic risk, i.e. operational risk and financial leverage risk, while an asset beta reflects only the underlying operational risk of the firm's assets. It follows that when estimating the beta of a firm based on comparators (see below), the effect of financial leverage needs to be 'stripped out' to derive asset betas. The derived estimate of the asset beta can then be transformed back to an equity beta using the leverage of the firm analysed. The relationship between equity beta and asset beta is given by the following formula:[27]

$$\beta_e = \beta_a \left[1 + \frac{L}{1-L} \right] \qquad (6)$$

  where β_a is the asset beta, i.e., the equity beta in the absence of debt.

  If a firm has no debt (i.e., it is entirely financed by equity and hence $L = 0$) then its asset and equity betas are identical. For otherwise identical investments, a

[27] The first formula of this type was developed by Hamada (1972). The specification of the relationship between equity and asset betas shown above assumes that debt is tax neutral and that debt has a zero debt beta.

company with more debt in its capital structure will have a higher equity beta and a higher required rate of return on equity than a company with less debt.

Estimating Betas

102. The estimation of betas is a difficult exercise and a contentious issue in cost of capital estimations. The beta of a firm can be estimated in three ways: direct estimation using historical returns for the firm in question; indirect estimation using local comparators; and indirect estimation using foreign comparators.[28]

103. As said before, beta measures the sensitivity of an asset's return to market returns – its exposure to undiversifiable or systematic risk.[29] In practice, the direct estimation of a firm's beta is carried out by regressing the return on the firm's equity on an asset against the return on an index representing the market portfolio. While in most regulatory settings the Commission is interested in the forward-looking level of systematic risk, only historical betas can be estimated. Hence, estimates of historical betas are used as a predictor of future betas. If the level of a firm's exposure to systematic risk has been altered within the period over which the beta is estimated, or is expected to change (e.g. because the firm is contemplating a change in its business mix), then its historical beta estimate is unlikely to be a reliable forward-looking indicator of the firm's underlying sensitivity to systematic risk.

104. The main issues involved in the direct estimation of historical betas include:[30]

- *Choice of a time period.* The choice of the time period involves a trade-off between the necessity to obtain sufficient observations in order to maximise the statistical reliability of the estimate (as measured by standard errors), and the desirability of deriving an estimate that reflects the firm's current characteristics in terms of business mix and leverage, i.e. a good proxy for the future. Equity betas vary through time because of changes in the level of leverage and changes in operational risk (e.g. divestiture or acquisition of a new activity).

- *Choice of return interval.* Returns can be measured over various intervals, e.g., daily, monthly, or quarterly. The use of short interval, i.e., daily returns, increases the number of observations and may improve the statistical accuracy of the estimate but also raises statistical problems and may be biased (e.g. non-synchronous trading). On the other hand, a longer interval (for example monthly) may be less prone to 'noise' problems, and would smooth out short-term variations not necessarily related to variations in systematic risk, but would require longer data series.

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[28] For more details on the estimation of betas see, for example, the references mentioned in footnote 26, The Brattle Group (2002) and Wright et al. (2003).
[29] Technically, the beta is defined as the covariance of the return on an asset and the market return, divided by the variance of the market return.
[30] The issues discussed below arise also when the betas of comparators are estimated and used to derive an estimate of the beta of the firm in question.

- *Market index.* The choice and nature of the market index affects the estimation of beta and its reliability. The equity market index used to estimate beta represents a proxy for the market portfolio. The use of the local index for the direct estimation of the beta of the firm in question may be problematic where the number of firms listed is relatively small and dominated by a few large firms. Furthermore, the composition of the market index, both in terms of firms' sizes, numbers and activities, can raise doubts as to whether it actually represents a good proxy of the market portfolio.

- *Relevant activities of the firm.* A further difficulty arises when the firm is active in a variety of different activities, but the Commission seeks to estimate the cost of capital of a particular activity. The overall amount of systematic risk faced by a company is the value-weighted average of the systematic risk of each of its individual business lines, which may differ greatly. Thus, it may be desirable to disaggregate a company-wide beta estimate into its component parts. However, disaggregating an overall beta into component parts corresponding to a firm's different business lines (each of which is not directly amenable to estimation) presents practical difficulties and data availability issues. It therefore involves a degree of judgment. Whether the Commission is seeking to disaggregate a company-wide beta or to isolate a particular activity of a firm, the beta can only be estimated by using comparators.

105. The appropriate treatment of these issues depends on the specific circumstances, and the need to derive a reliable estimate for the future. In fact, regression estimates at the firm level may have large standard errors and therefore may not be statistically reliable. Furthermore, it is worth noting that the characteristics of the New Zealand stock market cast some doubt on the overall quality of estimates based on domestic data.

106. In this context, drawing on comparator beta estimates may provide very useful additional evidence. This approach is particularly suitable when the direct estimation of beta is not feasible (e.g. the firm is not publicly traded) or the estimate is unlikely to be reliable. Another advantage of comparators-based estimates is that by averaging betas across firms, the standard error of the derived estimate may be significantly reduced, i.e. the statistical reliability of the estimate may be improved.

107. Comparators should ideally be similar in terms of the factors discussed above, and in particular with respect to the characteristics of their business activities. However, in some cases this may not be possible owing to the limited number of close comparators available. In specific circumstances (e.g. when there are few appropriate comparators), adjustments may be warranted to correct estimates for differences in regulatory regime or operational risk. The difficulty with this approach is that these adjustments are often ad-hoc or based on rules of thumb.

108. As mentioned above, in order to make meaningful comparisons, the effect of the capital structure needs to be removed by transforming equity betas into asset betas.

109. The estimate of beta depends on the sources of data used for the calculation. For example, the asset beta estimate for the gas pipeline industry relied on four sources of information.[31] Appropriate comparators were firms from the US and UK electricity and gas sectors. Adjustments were made for differences in regulatory regimes, and the higher risk of New Zealand gas businesses relative to the electricity line businesses.

Leverage

110. Leverage is the ratio of debt to total capital, i.e. debt plus equity. The Commission has in the past considered two main approaches for selecting the leverage weights used to determine the WACC:

- use of the current proportions of debt and equity in the firm capital structure; or
- use of the optimal financial leverage inferred from the capital structure of appropriate comparators.

111. In either case, the Commission uses market values, rather than book values, to derive financial leverage.

112. The Commission considers that if a firm's actual costs are used in assessing excess profits or setting prices, then the actual business leverage may be used to ensure consistency. If efficient costs are used, then optimal leverage could be used.

Cost of Debt

113. The cost of debt is the promised yield on debt, i.e., the interest rate required by investors to lend funds to or to hold bonds of the firm.[32]

114. The higher interest rate for lending to a company rather than a government is generally referred to as the debt margin or premium, which is measured as the difference between the yield on a corporate bond and the yield on a government bond of the same maturity, i.e. the risk-free rate. Recall from equation (2) that the cost of debt, k_d, may be computed as follows:

$$k_d = R_f + p \qquad (2)$$

115. The debt premium reflects the marketability of corporate bonds and the risk of default. Investors providing debt to firms are exposed to greater risk of default than when they hold government bonds.

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[31] See Commerce Commission (2004); and Lally (2004b).

[32] Strictly speaking, in the context of valuation where only expected returns are relevant, the cost of debt should be defined as the expected yield on debt. However, in most cases, the difference between the expected and promised yield on debt is slight and unlikely to be significant. Furthermore, the promised yield or contractual yield is easily observed, whereas the use of the expected yield would involve significant difficulties. See Ogier et al (2004: Chapter 5).

116. The size of the debt premium is linked to the firm's leverage, and more generally, to the overall financial position of the firm insofar as they both affect the risk of default.[33] The characteristics of industries may also affect the debt premium that firms face.

117. Firms generally use a wide variety of debt instruments. In principle, to establish the overall cost of debt, the weighted average cost of debt of various instruments should be calculated. However, in practice, it is simpler to derive a single measure of the cost of debt based on the debt premium, measured by the difference between a corporate bond yield and the yield on a government bond of the same maturity. Furthermore, this ensures that the cost of debt is estimated for the same period as that used to determine the risk-free rate (the period for which prices are fixed, and not the duration of a firm's assets or its debt), and thereby ensures consistency across the risk-free rates used in estimating the overall cost of capital.

118. The debt premium of a particular firm can be estimated in different ways.[34] These include: the direct observation of the actual premium paid by the firm above the risk-free rate; the estimation of debt premium based on the debt margin of close comparators (with similar credit rating for bonds of similar maturities). The actual choice of the method depends on the information available for a particular firm. In addition, the estimate must be consistent with the leverage level used.

119. In determining the debt premium, the Commission considers the actual debt premiums that firms pay above the risk-free rate, or, when the relevant information is not available, relies on the more indirect methods mentioned above.

Tax Rates

120. There are two tax rates used in the WACC model: the investor tax rate in the simplified version of the Brennan-Lally model, and the corporate tax rate in the cost of debt.

121. The investor tax rate is the marginal ordinary tax rate on investor income, which may include interest, dividends and capital gains. Under the simplified version of the Brennan-Lally model it is assumed that capital gains taxes are zero, firms attach maximum imputation credits to their dividends, and shareholders can fully utilise their credits. The Commission has used an ordinary tax rate of 33% in computing the cost of equity, and the statutory corporate tax rate of 33% in computing the after-tax cost of debt, in all of its decisions.

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[33] For instance, a firm in or near financial distress is more than likely to face a very high debt premium, and a firm whose leverage is increasing rapidly above the 'average' industry level may be expected to see its debt premium rising. In both cases, the premium captures the increasing risk of default.
[34] See, for example, Alexander (2004) and Ogier et al (2004) for more details.

Estimation of the Weighted Average Cost of Capital

122. Due to the inherent uncertainty attached to estimates of key parameters embedded within the WACC formula (especially the asset beta and the MRP), the Commission has in the past specified ranges for individual parameters, and on this basis, an overall range for the WACC. Within each individual parameter range, the Commission has generally, but not always, adopted mid-point estimates.

123. In its recent Gas Control Inquiry Report, the Commission introduced a novel approach to derive an estimate of the cost of capital. The approach, drawing on insights from statistics, sought to formalise the uncertainty surrounding estimates of the cost of capital, and therefore to improve the level of confidence that the cost of capital was set at an appropriate level. This approach may not always be feasible.

124. The approach, presented in Lally (2004b), involves several steps. First, point estimates for each (uncertain) parameter are calculated. Second, the standard deviations for each point estimate are chosen (this allows the definition of confidence intervals around each point estimate[35]). Although this second step is informed by available data used to derive point estimates, it is more an exercise that relies on expert opinion rather than any formal statistical methodology. The specification of standard deviations for each parameter therefore requires a degree of judgement. Finally, using the standard deviations determined for the individual parameters and the assumption that individual parameter are statistically independent, the standard deviation of the WACC distribution is computed. The probability distribution for the WACC is then derived assuming normality of the WACC distribution.

125. The example below, based on the parameters relevant to the gas industry, illustrates how the approach works in practice. The market risk premium was estimated at 7%, with a standard deviation of 1.5%. The asset beta was estimated at 0.5, with a standard deviation of 0.14. The risk-free rate averaged over July 2003 was 5%. Leverage was estimated at 40%, and the debt premium at 1.2%. The resulting point estimate for the WACC was 7.2% with a standard deviation of 1.2%.

126. Assuming normality in the WACC distribution, the percentiles of the WACC probability distribution are shown in Table 2.

Table 3: Percentiles of the WACC Distribution

Percentile	50th	60th	70th	80th	90th	95th
WACC	7.2%	7.5%	7.8%	8.2%	8.7%	9.2%

[35] By definition, the assumptions of normal distribution and that the point estimate represents the mean of the distribution imply that 68% of the distribution is contained within ± 1 standard deviation, and that 95% of the distribution is contained within ± 2 standard deviations.

127. Thus, given the assumptions made, it can be said that if one wished to choose a WACC for which there is only a 20% probability that the true value was more than this (i.e. 80th percentile), that WACC value would be 8.2%, according to this approach.[36]

128. In assessing excess returns or setting prices, the Commission has taken the view that the consequences of finding excess returns when they do not exist, or setting prices too low, are more severe than the contrary error. If the WACC were set too low, a firm would be discouraged from replacing assets or investing to expand output. Thus, consumers would not be able to obtain services they were willing to pay for, resulting in substantial efficiency and welfare losses. On the other hand, if the WACC were set too high, consumers may pay prices that are above the competitive level, leading to an overall welfare loss, or the firm may undertake investments that are not fully justified by demand. The overall costs of the latter are likely to be lower than the former.

129. Because of the uncertainties associated with estimating the cost of capital, and the asymmetric risks described above, the Commission generally chooses a cost of capital value that is either equal to, or above, the mid-point estimate or the 50th percentile. Given that the risks may differ across industries and circumstances, the Commission may select a WACC from different percentiles of the cost of capital distribution or range.

Allowances for Other Issues

Asymmetric Risks

130. Firms face asymmetric risks when the magnitudes of potential negative outcomes greatly outweigh the magnitudes of potential positive outcomes. Regulation can create asymmetric risks for firms by capping profits (e.g. through price setting), or penalising them for earnings excess profits, without providing compensation for being exposed to unexpected exceptionally unfavourable circumstances. Such unfavourable circumstances may include: the stranding of assets (through technical obsolescence or unexpected demand shocks); assets being optimised out by a regulator in response to stranding (due to unexpected cost shocks);[37] or miscellaneous exposures to unexpected events such as natural disasters.

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[36] The n^{th} percentile of the normal distribution can be computed by solving for x_n in the expression $z = (x_n - \mu)/\sigma$, where z is the standardised normal statistic, and μ and σ are the distribution's mean and standard deviation, respectively. For illustrative purposes, in the present example μ=0.072 and σ=0.012. Standard normal tables give the result $\Pr(0 \leq z \leq 0.845) = 0.3009$ and $\Pr(z \leq 0.845) = 0.8009$ (by symmetry). Substituting $z = 0.845$ and solving for x_{80} gives a value of 8.2% for the 80th percentile.

[37] Regulators sometimes optimise out assets for reasons such as 'gold-plating' or imprudent investment. This is quite distinct from the situation where an unexpected cost shock lowers the efficient replacement cost of installed assets, and the regulator responds by lowering the firm's rate base accordingly. The Commission considers that regulatory optimisation that results in the removal of gold-plated or imprudently invested assets from a firm's rate base should not lead to any additional compensation to the firm.

131. In the absence of regulation, firms may deal with potential adverse events either by raising prices ex post, or by raising prices ex ante to cover expected costs.

132. In setting prices or assessing excess returns, compensation for asymmetric risks could be achieved by: adding a margin to the cost of capital (either an ex ante or ex post adjustment); adjusting cash flows by the expected value of the risk (ex ante); or by allowing increased costs to be reflected in cash flows when they occur (ex post).

133. Ideally, in assessing excess returns, the Commission would know which approach the firm had adopted (ex post or ex ante), and would then assess returns correspondingly. If firms raised prices ex post in response to adverse events that had occurred, the increased revenues should perfectly offset the increased costs so that the effect on profits would be neutral. Thus, no adjustments to the WACC would be required.

134. If firms raise their prices ex ante in anticipation of adverse events, they then bear the risks of adverse outcomes occurring more or less frequently than anticipated. If the frequency and magnitude of events differ from expectations, then the measure of excess earnings could be misleading. This may be mitigated to some extent by conducting assessments over a period that is long enough to smooth out the impact of such events. If sufficient smoothing is not achieved, the Commission would need to form a judgment as to whether any excessive profits detected could be explained by a lower actual frequency for these extreme events than that reflected in the firm's ex ante cost forecasts.

135. In forming such a judgment as to whether profits are excessive, the Commission would need to form a view about the appropriate ex ante revenue allowance for such adverse events, and also to remove the impact of any such adverse events from the firm's actual costs to ensure that the firm was not being overcompensated. Making such adjustments is likely to be difficult.

136. If a firm were exposed to the possibility of assets being optimised out, then an ex ante allowance applied by the Commission, or a margin on the WACC, might be warranted. Similarly, if asset stranding were possible, and this could not be rectified through the firm raising prices ex post, then the Commission might need to consider making an allowance for these costs.

137. The Commission considers that if stranding or optimisation occurs as a result of removal of 'gold-plated' assets or imprudent investment, no allowance to revenues or margin on the WACC should be permitted.

138. The Commission prefers to handle the risks of adverse events, stranding and optimisation by adjusting cash flows, rather than by adding a margin on the WACC. For instance, in calculating the cost of the TSO, the Commission has accounted for asymmetric risks and the threat of asset stranding by reviewing, and if necessary adjusting, the parameters of the tilted annuity formula that generates the

depreciation profile of the firm's assets, and thereby the firm's expected cash flows.[38]

139. Such adjustments may be made on an ex post or ex ante basis, depending on the situation. While it would be desirable, in assessing excess returns, to match the approach used by the firms themselves, generally this information is not available, and neither is it simple to obtain an estimate of the appropriate ex ante adjustment. When a firm is regulated, the balance between ex ante and ex post adjustments can be explicitly defined in the 'regulatory contract'.

140. In light of the conceptual and practical difficulties involved with these issues, the Commission's approach is determined by practical considerations, and tailored to the particular circumstances.

Market Frictions and the Cost of Financial Distress

141. It has been suggested to the Commission that shareholders are exposed to the problem that losses on a particular project may make it costly or even impossible to raise further funds from capital markets. Yet without such funds, firms may have 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.

142. In the context of assessing excess profits, the Commission could handle such costs either on an ex ante or ex post basis. No action is required by the Commission if the firm caters for these costs through an ex post adjustment to prices. If the firm normally addresses these costs through ex ante price adjustments, then the Commission would also need to form a view on the appropriateness of an ex ante adjustment.

143. Furthermore, in the case of ex ante adjustment to cash flows or WACC by the firm, the Commission would need to assess the appropriate level, deduct it from actual revenues, and also deduct any *actual* costs (arising from market frictions or financial distress).

144. The Commission notes that it has no evidence that firms make ex ante adjustments to their prices, rather than recovering these costs as they arise. Additionally, the Commission considers that the burden of proof in demonstrating that an adjustment should be made lies with the firm.

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[38] Under this approach, the firm's capital cost is adjusted over time in line with the rate of increase or decrease of the optimized replacement cost of the capital equipment. Essentially, by adjusting the depreciation profile in this way, the firm is allowed to recover a greater proportion of its sunk costs earlier as a means of mitigating the threat of asset stranding.

Timing Flexibility

145. It has in the past also been argued before the Commission that where firms have an option to delay investment, commencing a project involves not only the direct cost of the project itself, but also the indirect cost of using up the delay option. That is, the sacrifice of the option is an additional cost (other than the direct expenditure on the project) for which the firm's owners require compensation, effectively raising the project's cost of capital.

146. The general principle, that delaying the timing of investment (to a point where expected rate of returns exceeds the standard WACC by some margin) is optimal for a firm in the presence of uncertainty and irreversibility, is well established at the theoretical level.[39]

147. One key issue for the Commission is whether or not the values of timing options are large enough to warrant detailed consideration. Delay options would only be expected to be valuable in very dynamic markets characterised by a great deal of uncertainty (e.g., markets in which there is rapid technological change where the cost of old technology may fall quickly, or where demand is very volatile). Conversely, in relatively static industries, the value (and therefore, impact on the cost of capital) of any extinguished timing options is likely to be small.

148. If timing options were proved to be valuable and significant, the Commission would have to address the question of whether or not an application of a margin above the standard WACC, to compensate for lost timing options, would be appropriate. If a firm were found to have generated a surplus when assessed using traditionally defined costs, with the cost of capital defined as the WACC, this surplus would be identified as excess returns. The Commission considers that if this surplus were due to the existence of a timing option, and this option were a manifestation of market power, identification of the surplus as excess profits would be appropriate.

149. It could be argued that timing options can arise even in competitive markets, in which case it might be appropriate to apply a margin to the standard WACC. Distinguishing this scenario from the exercise of market power is problematic.

150. Furthermore, if a firm had not *actually* benefited from a timing option, or had benefited in respect of *some* assets only, then applying a margin across all assets could disguise the earning of excess returns.

151. Additionally, if the sacrifice of a timing option warranted an increase to the WACC, then the creation of growth and/or abandonment options through investment might also warrant a countervailing reduction in the cost of capital.[40]

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[39] See, for example, Dixit and Pindyck (1994).

[40] Investment in capability today can allow firms to better exploit new market opportunities tomorrow. Thus, whilst the act of investing may extinguish a firm's timing options, it may concomitantly generate valuable growth options by providing a platform for expansion. Kulatilaka and Perotti (1998) demonstrate

152. The Commission considers that firms are in the best position to assess whether timing options are significant, and that the burden of proof lies with them. The Commission would need to be persuaded by the evidence presented that an adjustment were justified. In particular, the firm would need to demonstrate: that a timing option had been exercised; the value of the exercised option; the assets to which the option applies; that ability to exercise the option was unrelated to the exercise of market power; and finally, that the extinguishment of the timing option was not offset by the creation of other options.

153. In relation to price setting, the Commission notes that each project has a socially optimal time at which investment should occur, and regulators should be careful not to obstruct that. The Commission does not consider that adding a margin to a firm's WACC would ensure the optimal timing of investment. Given that 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.

Business Resource Constraints

154. It has also been argued to the Commission that some firms are unable to undertake all desirable projects because of resource constraints, such as limited managerial talent. Thus, undertaking one project may sacrifice other good 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).

155. The Commission once again considers that firms are best placed to assess the extent of these costs, and that the burden of proof lies with them. The Commission would need to be satisfied by the evidence presented by the firm that a specific adjustment for these potential costs was warranted.

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that the value of such growth options increase as uncertainty increases (higher uncertainty can mean more opportunity rather than simply more risk), and as the timing of investment is brought forward (in an environment of strategic competition, the firm that invests first can create a first-mover advantage for itself). The value of these growth options can potentially be quite large in expanding industries.

The act of investment can also generate abandonment ('shut-down') options for the firm. Abandonment options can be valuable to the firm, even in the presence of irreversible investment, because they allow the firm to halt operations when they become sufficiently unprofitable. The ability to do this allows the firm to avoid incurring ongoing losses. In this context, the value of an abandonment option can be thought of as the sum of the net scrap value of the project (which is likely to be small, or even negative, in the case of projects where costs are largely sunk) and the present value of all avoided future losses (which will increase with the level of uncertainty faced by the firm).

It is possible that the value of any growth and abandonment options created through investment may jointly overwhelm (or offset) the value of any extinguished timing options.

Conclusion

156. In deriving the cost of capital for a firm, the Commission calculates its weighted average cost of equity and debt, its WACC.

157. The Commission estimates the cost of equity using a simplified version of the Brennan-Lally CAPM.

158. The risk-free rate is used in calculating both the cost of debt and the cost of equity. The Government bond rate is used as a proxy for the risk-free rate. The term of the risk-free rate should match the regulatory period to ensure the NPV = 0 principle holds. The Commission considers that rates should be averaged over a period, to trade-off the timeliness of data against the smoothing of abnormal effects.

159. The various methodologies to estimate the MRP all provide insights that should be taken into account in estimating the market risk premium. The Commission's view is that the point estimate of the market risk premium is currently 7%.

160. In estimating the asset beta, the Commission relies on the direct estimation of the asset beta of the firm in question and the analysis of comparators' asset betas. In selecting comparators, the Commission seeks to select firms that face a similar level of systematic risk, and considers a number of factors, including the characteristics of the industry and the regulatory environment.

161. The cost of debt is estimated for the same period as that used to determine the risk-free rate. The cost of debt is determined as a premium over the risk-free rate.

162. Using the parameter values estimated by the Commission, it may be possible to derive a WACC with an associated statistical distribution.

163. In assessing excess returns or setting prices or a price path, the Commission notes that the consequences of finding excess returns when they do not exist, or setting prices too low, are more severe than the contrary error. The Commission therefore generally chooses a WACC equal to or above the mid-point or the 50^{th} percentile to reflect this asymmetry in risk. Given that the risks may differ according to different industries and circumstances, the margin adopted is a matter of judgment for the Commission.

164. The Commission has not in the past adjusted its estimate of WACC to account for the potential costs arising from asymmetric risks, financial distress, extinguished timing options, or firm resource constraints. The Commission considers that firms are best placed to assess the extent of costs arising from these unsystematic risks, and that the burden of proof lies with them. The Commission would need to be satisfied by the evidence presented by the firm that specific adjustments to allow for such costs are warranted.

165. The Commission's preferred treatment of any relevant unsystematic risks is through adjustments to cash flows, rather than through a margin on WACC. Adjustments

can be made on an ex ante or ex post basis, depending on the particular circumstances.

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