Response to the Commerce Commission's Gas Control Inquiry Draft Report : Estimation of the Weighted Average Cost of Capital

Prepared on behalf of :

NGC Holdings Limited

Powerco Ltd

Vector Ltd

Glenn Boyle

Tony van Zijl

Ryno Verster

2 July 2004

LECG
ECONOMICS
FINANCE

Table of Contents

1 Executive Summary

In the Commerce Commission's draft report on the Gas Control Inquiry of 21 May 2004, they provide estimates of the net acquirers' benefit (NAB) that may arise from regulating gas pipeline businesses. In addition, it is suggested that a form of rate-of-return regulation may be considered for the industry. In both cases the weighted average cost of capital (WACC) is a key underlying component of the calculations involved. The Commission employed Associate-professor Martin Lally to estimate the appropriate WACC for gas pipeline businesses.

Based on his findings, he suggests a range of between 6.1% to 8.5%. To allow for the inherent uncertainty in calculating the WACC and the asymmetric economic impact of setting the figure too low, the Commission recommends using a point estimate at the 75th percentile of this range, or 7.9%.

In this report :

a) we demonstrate that many of the parameters on which the Commission's WACC model is built are subject to major estimation errors. This implies that any point estimate for the WACC would be subject to significant errors,

b) we illustrate where the values assumed by Lally for various parameters are dated or incorrect, and provide alternatives for these,

c) we argue that the capital asset pricing model (CAPM) on which the WACC model is built, does not fully, or sufficiently, explain returns and that additional compensation for investors, in addition to the basic WACC, is therefore required,

d) show that there are potentially substantial costs to the economy if investors are not sufficiently compensated, and hence under-invest in infrastructure. This implies that the negative impact of setting the WACC too low far outweighs the impact of setting it too high, and

e) question the appropriateness of applying the WACC, which is a long-term measure, to determine excess returns in the short term. It is unlikely that the existence of excess returns would be accurately identified in the regulatory period suggested.

Based on the corrected CAPM parameters and applying the Commission's methodology, we estimate the following WACC range that should apply to gas pipeline businesses:

	Range	Midpoint
Asset Beta	0.45 to 0.65	0.55
Risk Free Rate		6.37%
Market Risk Premium	0.075 to 0.095	0.85
Debt Margin		1.70%
Leverage Ratio	55 to 65%	60%
Equity Ratio	45 to 35%	40%
Effective Tax Rate		33%
Equity Beta	1.0 to 1.86	1.38
Cost of Debt		8.07%
Cost of Equity	11.8 to 21.9%	16.0%
WACC	**8.3 to 11.2%**	**9.60%**

To allow for the uncertainty inherent to the CAPM parameters and the asymmetric economic impact of setting the WACC too low, adopting the Commission's suggestion of a point estimate at the 75th percentile of this range, gives a WACC of 10.5%.

In the regulatory environment proposed, and assuming that an ODRC or ODV asset valuation methodology would apply, companies would be subject to regulatory risks such as the optimising out or stranding of assets. In addition, there are indirect factors such as market frictions, timing flexibility and firm resource constraints that increase the hurdle rate for investment decisions. To compensate for these factors, investors require additional compensation over the basic WACC. The exact extent of the additional compensation required is uncertain, but indications are that allowing for this would imply an appropriate WACC point estimate that may be higher than the suggested range. We therefore suggest that the point estimate for the WACC should be taken from the top end of the suggested range, or 11.2%.

2 Introduction

The Commerce Commission released its draft report on the Gas Control Inquiry on 21 May 2004. In section 7 of the report, the Commission considers the weighted average cost of capital (WACC) that should apply to gas pipeline businesses. The Commission's view is based primarily on the recommendations of Associate-Professor Martin Lally, as set out in his report accompanying the Commission's release.[1]

We have been commissioned by NGC Holdings Ltd, Powerco Ltd and Vector Ltd to respond to the Commission's approach to setting the WACC and in particular to comment on Lally's report in this regard.

Determining the WACC is an important step in the regulation of the gas pipeline industry. It is a key parameter in the fundamental decision whether to impose control at all. In the calculation of the net acquirers' benefit (NAB), which is a critical indicator for the Commission's decision, the WACC is integral to calculating excess returns. Excess return forms the bulk of the potential NAB that could arise from regulating the industry.

Under the building block model WACC is a key parameter in determination of the level of acceptable returns to companies. Hence it is fundamental to the tariff-setting process and for measuring whether companies are receiving excess returns.

Utilities have been concerned about the Commission's approach to setting the WACC and have at various stages of the regulatory process for various industries, made or sponsored a number of submissions to critique this approach and to offer suggestions for improvement. The inquiry into the gas pipeline businesses is only the most recent in a long series of similar activities.

It is therefore disappointing to note that the Commission, through Lally, does not appear to pay much heed to these submissions and has, but for some small exceptions, not been prepared to move from its predetermined position, in spite of the strong arguments and evidence raised to indicate the need for such movement.

- In this submission we again highlight the shortcomings and inherent uncertainties underlying the capital asset pricing model (CAPM), on which the Commission's WACC estimate is based and the problems that exist in applying it to the regulation of infrastructure providers. We also indicate where some of the underlying parameters used by the Commission is dated, or incorrect.

3 Comments on WACC model and parameters

3.1 WACC Model

As discussed in van Zijl and Verster (2003a), the Commission's definition of the WACC is widely used and uncontroversial.

[1] Lally (2004)

$$WACC = k_e(1-L) + k_d(1-t_c)L \quad (1)$$

where k_e is the cost of equity, k_d is the cost of debt, t_c is the corporate tax rate (assumed to be 0.33), and L is the leverage ratio. Thus $WACC$ is defined as a weighted average of the cost of equity and the (after tax) cost of debt.

Determining the cost of equity is rather more controversial. The formula proposed by the Commission is the CAPM adjusted to reflect the New Zealand dividend imputation tax system:

$$k_e = R_f(1-0.33) + \beta_e TAMRP \quad (2)$$

where R_f is the risk free rate, β_e is the equity beta coefficient, and $TAMRP$ is the tax-adjusted market risk premium given by:

$$TAMRP = R_m - R_f(1-0.33) \quad (3)$$

with R_m being the expected rate of return on the market portfolio of risky assets. Equation (2) is commonly referred to in New Zealand as the 'post tax' form of the CAPM.

In the absence of a better descriptive model for k_e, we accept the CAPM and specifically the post tax form, as an acceptable starting point for the New Zealand situation. However, accepting this, or any other version of the CAPM, should be done with some care. As outlined in Boyle (2003a), there are serious shortcomings and inaccuracies in the CAPM and any results obtained through it should be seen in that light. Boyle (p4) states:

"Now, let me say that I think the CAPM is a beautiful model. It is elegant, intuitive and simple, and, of course, it has also generated a Nobel prize. Unfortunately, it doesn't seem to work very well. As a result, finance researchers have become increasingly sceptical about the practical value of the CAPM. This modification of the profession's views is neatly summarised by Cochrane (2000):

> *"We once thought that the CAPM provided a good description of why average returns on some stocks, portfolios, funds, or strategies were higher than others. Now we recognise that the average returns of many investment opportunities cannot be explained by the CAPM..." (p36)*
>
> *"In sum, it now appears that investors can earn a substantial premium for holding dimensions of risk unrelated to market movements..." (p56)*

Although Cochrane's views are based on US evidence, there is good reason to believe that they also apply to NZ. In the most extensive NZ test of the CAPM, Bartholdy et al (1997) found that the CAPM could explain at most only 11% of the cross-sectional variation in stock returns. In other words, expected stock returns seem to be largely independent of beta. " [2]

His conclusion (p5) is :

[2] We do of course recognise the problems that arise in empirical testing of the CAPM as identified in Roll (1977) and Roll and Ross (1994).

"What all this demonstrates is that the standard CAPM fails to account for potentially important sources of risk. Because of both additional "bad times" variables and common variation in discount rates, the CAPM is likely to provide only a very rough approximation of the pricing of financial securities. Consequently, any expected return estimate based on the CAPM needs to be treated with a great deal of caution. "

The implication is that, while we do not have a better model with which to estimate k_e, clearly an allowance should be made for the shortcomings in the CAPM and the errors that its application could imply. The regulatory regime that the Commission is considering for gas pipeline businesses is a very serious intervention with a huge potential impact on the businesses. It is therefore essential that any decisions in this regard should reflect awareness of these serious implications. Where there are potential flaws in the Commission's approach or models used, as is demonstrably the case with application of the CAPM, the compensation arrangements should make appropriate allowance for this. Ignoring such shortcomings because they are difficult to address is not an acceptable response and is not tenable when imposing control on businesses.

Although the paper referred to above (Boyle 2003a) was submitted in the context of electricity lines businesses, the arguments equally apply to gas pipeline (and other) businesses. The magnitude of the shortcomings is difficult to estimate but we believe they should be recognised by significantly expanding the range of potential k_e values used in the WACC calculation.

We now turn to the basic parameters underlying the CAPM and WACC calculation.

3.2 Basic parameters

As a general comment, we note that Lally used July 2003 values as the basis for the CAPM parameters. The reason for this is not clear, although the date may have been chosen to coincide with the starting date of the gas inquiry. In any event, since control may be imposed in the future (there has been no suggestion of imposing control retrospectively), the most current WACC value should be determined. This should especially be the case when considering returns for 2004 onwards. Where the WACC is used on past estimates for the purpose of the NAB test, it would be appropriate to calculate the correct estimate for each of these years.

In addition, we note that the Commission in its NAB calculations assumed a five-year regulatory control period to estimate the direct costs of control.[3] However, Lally based his WACC calculations on a three-year regulatory period. It is not clear what the Commission's final intentions in this regard are, but regardless of the control method adopted, this inconsistency needs to be addressed.

3.2.1 Asset beta

Ideally beta should be estimated from market data on the company (investment) in focus. However, this approach is problematic in the context of the gas inquiry for two main reasons :

[3] Pars. 5.50 and 5.61 of the Commission's draft report on the gas control inquiry.

- The Commission uses the WACC mainly to determine the extent of excess returns, which generally constitutes the largest component of the net acquirers' benefit calculation. For the NAB test, a hypothetical optimum company is assumed, which implies a standard risk profile for all measurements.

- The statistical base from which to calculate beta estimates for gas pipeline businesses in New Zealand is insufficient. The only two gas pipeline companies currently listed do not have long-term data series on returns and both have been subject to significant internal restructuring over the last few years. This makes it difficult to separate out information relating to their gas pipeline operations from the overall company information.

By virtue of their chosen methodology, the Commission is therefore forced to estimate an industry-wide beta estimate based on considering the underlying factors that affect the risk-profile of gas pipeline businesses and by using comparable international companies as a benchmark.

We understand this difficulty and accept that the Commission's approach, while likely to involve a considerable degree of approximation, is a practical way of obtaining beta estimates. However, there are obvious, and major, problems with this approach, as discussed below. We do not believe that these problems should completely negate the Commission's approach, but they do emphasise the level of uncertainty under which the Commission's decisions are made and the huge potential for errors in these estimates.

Suggested range for asset beta estimate

Lally's position is that the asset beta should lie in a range of 0.4 to 0.6, with a point estimate of 0.5. This is based on his conclusion that the beta used for electricity lines businesses should provide an acceptable proxy for gas pipeline business, but allowing for a moderately higher asset beta to reflect the higher volatility in gas consumption.

If the uncertainty arguments raised below are put aside, we essentially agree with Lally's calculation, but with the following provision. The asset beta range for electricity lines business as set out in Lally (2003) was based on material collected from the Damodaran website.[4] However, he has consistently used an average asset beta estimate of 0.3 for electricity utilities, in spite of Damodaran's latest average for these utilities being 0.37 and this having been pointed out repeatedly.[5] [6] In Lally (2003) it is acknowledged that the latest Damodaran estimate is 0.37, but this is then, inexplicably, ignored since :

> *"Estimates of this type are subject to estimation error, and therefore one should weight the results from a variety of periods. Furthermore, precision beyond one decimal point is difficult to obtain."*

[4] http://pages.stern.nyu.edu/~adamodar/

[5] Damodaran reports the unlevered beta for 28 Central utilities at 0.35, for 29 Eastern utilities at 0.3 and for 16 Western utilities at 0.33. The average asset beta for these 73 utilities is therefore 0.37.

[6] This was pointed out in for example van Zijl and Verster (2003a) and (2003b)

Not only would rounding to one decimal point imply an asset beta of 0.4 (not 0.3), but Damodaran already takes into account a five-year period in his calculations of the asset beta.

In Lally (2004), it would appear that the asset beta estimates from earlier Damodaran reports are now also being considered, or a range from 1990 to 2002. Deriving an average asset beta estimate from an extended period is problematic, especially if an equal weighting is given to all results. Contrary to the consideration of for example the market risk premium, which relies on the aggregate changes of the whole market over time, the asset beta reflects the systematic risk profile of a single business. The risk profile of an individual business is subject to factors that would have no, or only a nominal, impact on the general market (such as technological changes or changes in consumption patterns directly affecting the business in question). In assessing the asset beta, it is therefore important to give more weighting to a business' current risk profile rather than its historical risk profile. Changes that can have a major impact on an individual business risk profiles (such as technological changes or consumption trends)

Even if asset beta is generalised to that for a single industry, a single industry is still far more subject to changes in risk profile than the overall market. The beta estimates for the industry should therefore still be based on recent performance, hence Damodaran's use of performance data for the most recent five year period when determining the asset beta. We therefore do not agree with Lally's use of past data beyond the last five, or at most ten years to determine the risk profile of a particular industry.

In addition, even if Lally had taken the data for 1990 – 2002 into account in determining the beta for electricity lines businesses (which was never stated), the average beta thus calculated would still be 0.35.

In all cases this would suggest an upward correction of at least 0.05 in his beta range for electricity lines businesses. Given Lally's approach to calculating the asset beta for gas pipeline businesses from that of electricity lines businesses, this yields a range of 0.45 to 0.65 for gas pipeline businesses.

In stating this range, it is important to recognise the degree of uncertainty underlying the beta estimates. This is discussed below.

Form of regulation

There is still some uncertainty about the type of regulation that the Commission is considering for the gas pipeline businesses, but it would appear to be a building-block approach, or rate of return regulation based on an ODV asset valuation methodology. This approach was followed in the NAB test.

Lally argues that increasing the period of regulatory review would tend to increase the asset beta, since firms would be less likely to adapt their prices within the regulatory window and thus be more subject to market shocks. As he suggests a three-year regulatory period, he argues that New Zealand firms would therefore have a lower asset beta than their UK counterparts, where a 5-year window applies, and a higher asset beta than their US counterparts who are subject to annual resets.

However, as noted before, the Commission indicated that a five-year regulatory period would apply. This would imply a higher asset beta than that suggested by Lally.

In considering the impact of the regulatory period on the asset beta, it should be noted that the asset valuation methodology used by a utility would also have an impact. Evans and Guthrie (2004) show that short regulatory periods could add additional risks to firms using the ORC methodology (which is essentially the same as ODV). Here firms are exposed to the additional risk of demand shocks, affecting the outcome of the optimisation process, or capital price shocks, affecting the calculation of replacement cost – risks which are mostly limited to regulatory review points and will hence be more evident with shorter review periods. . The extent to which the reduction in market risks implied by a shorter regulatory period would be offset by an increase in demand or capital price shocks, is not clear.

Adjusting international data for New Zealand firms

Based on a list of beta determinants, Lally adjusts the beta estimates obtained from international comparators for use in the New Zealand context by reflecting the impact of local leverage and allowing for some differences in the regulatory environment.

In doing so, however, he seems to ignore the work of Campbell (1991), Cornell (1999) and others on the primary determinants of beta. Using the Campbell decomposition, unexpected returns $x_{i,t+1}$ at time t+1 can be written as:

$$x_{i,t+1} = (E_{t+1} - E_t)\{\sum_j \rho_j \Delta d_{i,t+1+j} - \sum_j \rho_j h_{i,t+1+j}\} \quad (4)$$

d_i is the firm i dividend, h_i is the firm i one period return, and $\rho \in (0,1]$ is a constant. Intuitively, this equation simply says that any innovation to returns must stem either from revisions to expectations about future dividends (cash flows) or from revisions to expectations about future returns (discount rates).

It is helpful to rewrite the above equation as:

$$x_{i,t+1} = x_{di,t+1} - x_{hi,t+1} \quad (5)$$

where x_{di} is the component of unexpected returns that is due to revised expectations about future dividends and x_{hi} is the component of unexpected returns that is due to revised expectations about future returns (discount rates). Equation (5) must also hold for the market portfolio:

$$x_{m,t+1} = x_{dm,t+1} - x_{hm,t+1} \quad (6)$$

Recall that firm i's beta is equal to $\text{cov}(x_i, x_m)/\text{var}(x_m)$. Using (5) and (6), the numerator of beta is:

$$\text{cov}(x_i, x_m) = \text{cov}(x_{di}, x_{dm}) - \text{cov}(x_{di}, x_{hm}) - \text{cov}(x_{hi}, x_{dm}) + \text{cov}(x_{hi}, x_{hm}) \quad (7)$$

All of Lally's arguments, and resulting estimates, are based on the first term on the right hand side of (7) - the common variation in expected cashflows between asset i and the market portfolio. But, as (7) makes clear, this ignores the importance of common variation in discount rates and in common covariation in expected cashflows and discount rates.

Indeed, Campbell and Mei (1993) report that, other than for cyclical industries, virtually all of beta is attributable to the components associated with variation in discount rates.

Obviously, therefore, adjustments to own-data estimates of beta based on factors that have a limited impact on beta, while ignoring those with a potentially larger impact, is likely to lead to inaccuracies.

Ferguson- Shockley bias

In Boyle (2003a), the Ferguson and Shockley (2003) bias argument is raised. If the CAPM holds, then the equity beta estimated from an equity proxy for the market differs from the true equity beta. Lally agrees to this proposition but makes no allowance for the impact thereof due to a lack of returns data on non-equity assets and because the bias would also exist in the market risk premium and would tend to offset the bias in the beta.

Assuming that the bias in the beta and the market premium would offset each other seems a brave presumption. First, when one looks at the debt securities available in the NZ market, it is by no means clear that their inclusion would in fact lower estimates of the market risk premium.

Second, even if this were true, the market risk premium term is the same for all firms. The Ferguson-Shockley effect would still imply firm-specific variation in under- or over-estimation of beta, depending on the firm's leverage. Lally makes no allowance for this.

Indeed, Lally's assertion that the whole point is "moot" because of a lack of debt data ignores the subtlety of the Ferguson-Shockley argument, namely, if the standard CAPM holds then the correct way to implement it is to use leverage and distress factors in addition to the market portfolio. In other words, whatever the effect of expected debt returns on the market risk premium, the correct way of correcting for the Ferguson-Shockley bias is to allow for additional pricing factors, not to simply ignore the bias. We accept that this adds complexity to the estimation procedure, but would argue that at the very least it should be recognised that the downward bias in the estimate of the equity beta adds to the overall uncertainty of the estimate.

3.2.2 Market risk premium

As with the asset beta, we caution that estimation of the MRP is highly subjective and prone to significant error.

Commission's approach

Lally discusses the estimation MRP from a number of perspectives. He accepts that all of the methods of estimation of the MRP - historical averaging, the constant reward to risk methodology, forward-looking approaches and survey evidence - have limitations. He recognises that using just New Zealand data is open to question and that there are advantages from considering other markets. His solution to existence of the limitations is to simply average the estimates provided by the different methods. He thus determines that the MRP should be in a range of 0.06 to 0.08, with a median value of 0.07.

We see several problems with this approach.

- It is untenable to attach an equal weight to all the estimation methods, as suggested. In spite of the fact that all the methods may be flawed in some manner, this does not suggest that all are equally worthy. Some of the methods, as discussed below, are of dubious value and it is hard to see how they can be afforded the same weight as those based on thorough research.

- In spite of the fact that he recognises the deficiencies in using New Zealand data from periods before 1985, Lally still include results that incorporate this.

- The forward-looking approach relies heavily on forecasts. While the approach may be conceptually elegant, the huge uncertainty and subjectivity surrounding the forecasts makes it unsuitable as a basis for regulatory decisions.

Overall, of the methods considered by Lally and the Commission, we would only give credence to the historical data approach, based on the data presented in Dimson et al (2002) (2003). The current New Zealand ten-year government bond yield, as at 15 June 2004, is 0.0637.[7] In addition, the latest data provided by Dimson et al (2003), indicates a MRP of 0.064. Applying the tax adjustment this yields an estimate of 0.085 for the tax adjusted market risk premium (TAMRP). Using Lally's range, this would indicate the TAMRP to lie between 0.075 and 0.095.

Once again, using a narrow range estimate for an uncertain parameter should be approached with caution. The uncertainty relating to the MRP is discussed below.

Uncertainty in determining the market risk premium

In Boyle (2003a) we provided an illustration of how two different approaches to determining the MRP, both of which are consistent with the CAPM itself, can produce vastly different results. This was to demonstrate the potential level of uncertainty that exists in these calculations and therefore that the range accepted for the MRP is potentially much wider than suggested by Lally. However, Lally rejects this argument, so we offer further clarification.

The two calculation methods proposed were as follows :

$$MRP = \gamma \, var(R_m) \qquad (8)$$

$$MRP = \gamma \, cov(C, R_m) \qquad (9)$$

By using New Zealand market returns between 1950 and 2000 and typical values for the constants, equation (8) indicates a MRP of 30% and equation (9) a MRP of 1%.

We concluded that these results seem implausible, but that if the CAPM is accepted as an appropriate model for calculating risk premia on individual assets, the methods described in (8) and (9) must both be accepted as being at least as valid as those discussed by Lally.

[7] The rate is obtained from the Reserve Bank of New Zealand, based on the average for the preceding month and has been converted to an annually compounded rate using the following relationship: $R_f^{annual} = \left(1 + \frac{R_f^{semi-annual}}{2}\right)^2 - 1$

From this it follows that determining the true value of the MRP is demonstrably not straightforward and that it would be prudent to allow a wide range for the MRP.

In considering this argument, Lally firstly claims that it is "not unusual for parameter estimates" to be generated independently of the model in which they are being used. That is true, but not in the sense described here. Typically, a model contains certain exogenous parameters whose values are different from, or independent of, the variable being modelled (e.g., investor risk aversion). In the case here, however, the variable modelled is the expected return on some asset. The market risk premium is a weighted sum of all such expected returns, so its value is, by construction, directly related to the variable being modelled. Thus, any sensible application of the CAPM should use a value for the market risk premium that is explicitly consistent with the CAPM pricing process.

Secondly, Lally claims that equations (8) and (9) cannot both be true. It's unclear how this is relevant (since the point of the analysis was to show that alternative methods of estimating the market risk premium can lead to widely diverging results), but in any case the claim is not in general true. Suppose, for example, that consumption growth is a simple linear function of the return on the market portfolio:

$$C = a + R_m$$

then substituting this into (9) yields

$$MRP = \gamma \, cov(R_m, R_m) = \gamma \, var(R_m)$$

i.e., equation (8).

Thirdly, Lally claims that the standard CAPM rules out equation (9). However as was explained in Boyle (2003a), the standard CAPM is in fact a special case of (9) (e.g., when consumption growth is a linear function of market returns), so far from it ruling (9) out, (9) *must* hold for the standard CAPM to be valid.

Fourthly, Lally claims that any MRP estimate based on equation (9) should then be used in individual-asset applications of (9) rather than his equation (3) (the post-tax version of the CAPM). Since, as noted above, his (3) is simply a special case of his (9), this does not necessarily follow (it only follows in the case where his (3) - the post-tax version of the standard CAPM - does not hold). In any event, logical consistency would then require that other MRP estimates could only be inserted into pricing models that give rise to such estimates, which is exactly the type of consistency that Lally claims is unnecessary.

Fifthly, Lally cites a number of other studies using or obtaining different estimates of $Var(R_m)$ and γ. Regardless of the competing merits of these claims (and it is virtually impossible to explain any aspect of aggregate portfolio choice or asset pricing with values of γ as low as 2, as suggested), Lally's conclusion that the model admits "a wide range of possible results" and thus requires "caution in placing any weight upon (them)" is exactly the point made in Boyle (2003a).

Finally, Lally argues that equations like (8) and (9) yield values that seem totally inconsistent with other methods. Again, this is exactly Boyle's (2003a) point.

3.2.3 Risk free rate

Lally argues that the risk free rate should be subject to a period of averaging and suggests using the average rate over the preceding month. We agree with this approach.

However, he also suggests that the appropriate term for the risk-free rate should be similar to the regulatory review period, an approach that he has proposed in assessing the WACC for electricity lines businesses and the Telecom TSO obligation as well. A period of three years is suggested.[8]

In support of his contention, Lally provides an example (Lally 2003) that purports to demonstrate how the use of risk free rates with periods longer than the regulatory review period would lead to "double-dipping". This is in the sense of a firm being rewarded for future high interest rates not only when they occur, but also in anticipation of it. While the example illustrates over-recovery in the limited situation considered, it should be noted that :

- By simply turning the rates assumed in the situation sketched around, it could be demonstrated that the firm loses out in the period when current interest rates are high, but lower future rates are anticipated. Interest rate movements are cyclical and at times the short-term rates would be higher than the longer-term rates.

- The assets being considered generally have a much longer lifespan than the ten years indicated in his example, which will stretch over many regulatory periods. During some of these periods it may be possible to receive excess returns because the ten-year bond rate would overstate the actual risk-free rate during the regulatory period and at other times there will be under-recovery. Over time, on average, there will be as many upside as downside periods (unless of course the expectation is that interest rates will continue to rise in future, or will remain constant after an initial period of rising).

There does not therefore appear to be any major benefit from using shorter terms for the risk-free rate.

On the other hand, there are arguments why a long-term rate is appropriate.

a) Standard finance practice is to match as closely as possible the duration of the risk free rate to the lifespan of an investment. This better reflects the commitment investors enter into when they acquire infrastructure assets with lifespans on average much longer ten years, and the fact that once these investments are made it is sunk. Investments are therefore locked in.

   This idea was supported in a recent speech by the Finance Minister, delivered as part of the NGC Winter Lecture Series. He raised the concept of infrastructure bonds and suggests that the lifespan for these would be much longer than that of standard bonds.[9]

---

[8] The Commission suggests a five-year period.

[9] Speech delivered on 22 June 2004 by the Hon Michael Cullen for the NGC Winter Lecture Series : Infrastructure and the Economy.

> *"An infrastructure bond would differ from a conventional government bond in that it would be directly linked to new infrastructure investment (for example new roads) and would be likely to have a significantly longer term of 20 to 25 years as opposed to the normal 5 to 12 year term."*[10]

b) Using short-term risk-free rates introduces an additional and unnecessary degree of volatility and uncertainty into the businesses. Movements in the risk-free rate then become another factor which may have to be hedged against.

c) Using a short-term risk free rate is inconsistent with using a long-term rate for calculating the MRP.

The Commission noted the recent Australian "Gasnet Decision"[11] where the Tribunal noted that mathematical consistency in applying the CAPM requires the same risk-free rate to be used in both parts of the equation where it occurs. However, the Commission appears to reject the relevance of this finding, since :

> *"the legal framework underlying the GasNet decision is distinguishable from that of the Commission's powers under the Commerce Act. Unlike the ACCC in the GasNet decision, the Commission in the Inquiry is able to choose the methodology that it considers most appropriate for the purposes of the Inquiry."*(par 7.47)

The Commission therefore appears to say that where the standard CAPM does not suit its purpose, it can adapt it as required. Given that the CAPM is a Nobel-prize winning economic model that is commonly used to estimate the cost of capital, it appears highly unusual that this can merely be rejected, or adapted based on own preferences that are not supported by published, and generally-accepted, research.

At the very least, if the Commission intends to use a model that differs significantly from the CAPM, it should not claim to be using the CAPM, or at the very least be very clear where it deviates from this and what the implications of this deviation are.

Lally also rejects the consistency requirement as "not compelling" and "flawed", ostensibly on the grounds that such "consistency" "rests on the assumption that the expected market return is the same for all future periods...".

However, the "consistency" view is in fact simply a mathematical artefact of the CAPM. Lally recognises this in the special case where beta equals one, but does not admit its general applicability. In the world populated by the mean-variance investors that gives rise to the CAPM, the mathematics of the portfolio frontier tell us that the expected return on any asset or portfolio i is a linear combination of the expected rates of return on a frontier portfolio and a portfolio that has zero covariance with that portfolio (see, for example, Huang and Litzenberger, 1988, pp91-92). If a riskless asset exists, then it has a zero covariance with any frontier portfolio and therefore:

$$E[R_i] = (1-\beta_{ip})R_f + \beta_{ip} E[R_p] \qquad (10)$$

[10] Ibid. Speech notes, p3.

[11] Par 7.41 of the draft report on the gas control inquiry ("Gasnet Decision" is the Commission's terminology)

where $E[R_p]$ is the expected return on frontier portfolio p and β_{ip} is the beta of asset i returns with frontier portfolio p returns. Note that this is simply a mathematical fact, devoid of any economic reasoning. However, by assuming homogeneous expectations, market equilibrium implies that the frontier portfolio held by every investor is the market portfolio m. Thus, a form of (10) that does have economic content is :

$$E[R_i] = (1- \beta_i)R_f + \beta_i E[R_m] \quad (11)$$

where β_i is the standard asset i beta. Rearranging yields

$$E[R_i] = R_f + \beta_i \{E[R_p] - R_f\} \quad (12)$$

which is the CAPM. However, the process by which this is obtained demonstrates conclusively that there is only one risk free rate in the CAPM, at least if one applies that model correctly. Using different risk free rates is not the CAPM.

Lally argues that data limitations preclude the use of the same risk free rate because the "first term" in (12) must be the two-year rate and data for this rate are unavailable over a sufficiently long time period to allow historical estimation of the stockmarket premium over and above this rate. This argument is flawed on two counts. First, as the argument leading to (11) demonstrates, there is no "first term" and "second term"; there is simply one risk free rate term. Second, faced with an incompatibility between an unpublished result and a long-established (Nobel Prize winning) result, it seems 'courageous' to opt for purity of the former while sacrificing the latter.

The implication is that, if the Commission wants to use a short-period risk free rate, the similar period will have to be used to determine the MRP, which as Lally rightly points out, is problematic because of data limitations.

Accordingly, we recommend that the yield on 10-year bonds be used as proxy for the risk free rate. As noted above, this rate is currently at 6.37%.[12]

3.2.4 Leverage

There is no analytical basis for determining an optimal capital structure and therefore what is optimal is best inferred from practice. Accordingly, we would recommend that the leverage should be taken from company target levels of leverage. In the case of NGC, their leverage is currently 58%. For Vector it is 68% and for Powerco 65%. The Commission's estimate of 40% is therefore too low and we recommend a range of 55% to 65% should be used.

We do concur with Lally that it is not necessary to assess the level of leverage with great precision as the impact on WACC of variation in the estimate is modest. The impact is certainly of a much lower order than applies in respect of variation in the other CAPM parameters.

[12] The current value for 3-year bonds is 6.12%, based on an average of the annualised 2-year and 5-year figures as provided by the Reserve Bank.

3.2.5 Debt premium

In our view, the amount of the debt premium is a simple empirical matter that should be settled given an assumed capital structure. We expect that Lally's estimate of 1.2% is at the low end of the spectrum and that a more realistic estimate, for a leverage of 60%, would be 1.7%, based on the average debt margins for NGC, Vector and Powerco.

3.3 WACC estimate

Based on the discussions above and putting aside for the moment the arguments about the considerable uncertainty in estimating these parameters, we present below a comparison between Lally's current estimates and the estimates as we suggest they should be corrected.

	Lally proposal		LECG proposal	
	Range	Midpoint	Range	Midpoint
Asset Beta	0.4 to 0.6	0.5	0.45 to 0.65	0.55
Risk Free Rate		5.00%		6.37%
Market Risk Premium	0.06 to 0.08	0.07	0.075 to 0.095	0.85
Debt Margin		1.20%		1.70%
Leverage Ratio		40%	55 to 65%	60%
Equity Ratio		60%	45 to 35%	40%
Effective Tax Rate		33%		33%
Equity Beta	0.67 to 1.0	0.83	1.0 to 1.86	1.38
Cost of Debt		6.20%		8.07%
Cost of Equity	7.4 to 11.4%	9.20%	11.8 to 21.9%	16.0%
WACC	6.1 to 8.5%	7.20%	8.3 to 11.2%	9.60%

As discussed, the above ranges are subject to major assumptions and inaccuracies. Given the seriousness of the purposes to which these estimates may be put, it is therefore essential to incorporate some form of compensation to account for the likely error in whatever final estimate is decided upon. In section 5, we discuss the asymmetric impact of an error in selecting a WACC estimate. To guard against the negative impact, we would suggest adopting a WACC estimate from the higher end of the range. The Commission recognised this and suggest adopting an estimate at the 75th percentile of the range (7.9%), which would suggest a corrected point estimate for the WACC of 10.5%.

While it is not clear on what basis the 75th percentile figure was adopted, this assumption, in combination with using the corrected WACC range as suggested, would limit the potential negative impact from setting the WACC too low. We therefore agree with the principle of using a figure from the higher end of the estimated range and the use of the 75th percentile as a starting position.

However, there are several additional indirect factors and factors associated with regulatory risk that would imply that the WACC estimate should be further modified. This is discussed in the next section.

4 Regulatory risks and indirect costs

In our earlier submissions[13], a number of factors have been raised for which utility firms could legitimately expect compensation in addition to the WACC estimate. These include the risks inherent to the form of regulation being proposed, defined by Lally as asymmetric risks – assets being stranded, being optimised out, or being exposed to miscellaneous adverse events for which the risk cannot be mitigated. It also includes certain indirect factors for which rational investors would require compensation, but which are not captured by the WACC formula.

The overall point with regard to these indirect factors is that while the WACC, even if subject to severe flaws in the estimation of its underlying parameters, can give some guidance for investment decision making in a static environment where no market imperfections exist, in reality businesses find themselves in a dynamic environment, where market imperfections are common. The result is that investors require a premium over the WACC before investments are made – in fact it would be rare for a project with a zero NPV to be accepted. The true hurdle rate for investment decisions is therefore higher than that indicated by the WACC on its own.

Compensation for the various types of additional risk could be in the form of inclusion in future estimates of expected cash-flow, in adapting the asset base used for measurements or by adapting the WACC. An appropriate adjustment to the WACC is mathematically equivalent to the other methods. It would have the additional benefits in the proposed regulatory environment of providing a common standard across all gas businesses[14] and also by clearly signalling to investors in rate-of-return terms of what adjustment to WACC will be acceptable to the Commission.

Lally recognises that the market imperfections or dynamic market conditions exist and would influence investor decision-making. However, his only concession, which he repeats for a number of different risk factors, is that adequate provision has been made by virtue of :

a) the fact that the use of a domestic version of the CAPM with international parameters is advantageous to local firms, as he claims that it would tend to overstate the WACC, and

b) his recommendation that a WACC estimate from the upper end of the suggested band should be used.

In this manner, he suggests that these factors will provide sufficient compensation for :

- the possibility that the WACC estimate is too low (p43),
- the fact that the consequences of judging excess profits to exist when they do not are more severe than the contrary error (p43),

[13] See for example Boyle (2003a), van Zijl and Verster (2003a) and (2003b)

[14] Cash-flow adjustments would have to be company specific

- asymmetric risks such as the risk of assets being stranded, assets being optimised out or of miscellaneous exposure to events such as natural disasters, (p58) and

- the cost of financial distress (p62).

It is by no means conclusive that the use of a domestic version of the WACC with international parameters would in fact overstate the WACC. Even if accepting this, in our view it is highly unlikely that this 'concession' and using a value for WACC from the higher end of the range, would provide sufficient compensation for all the factors listed above.

We do not consider using a WACC value from the higher end of the range as a "concession" – the range merely reflects the uncertainty in the underlying parameters and the fact that the WACC cannot be accurately determined. The true WACC could lie anywhere within the band, with equal probability. Using a point estimate from the higher end of the range is therefore to compensate for the asymmetric economic impact of potentially setting the WACC too low. It does not provide additional compensation for various additional factors, as Lally suggests.

4.1 Optimisation and stranding risk

Assuming that an ODV or ORC asset valuation methodology is used, the risk arises that the regulator may optimise out assets from a company's asset base, based on various accounting rules. [15] These are risks that are inherent to the form of regulation proposed.

Stranding occurs where assets are under-utilised to the extent that the costs associated with these assets cannot be recovered. In a regulated environment, businesses may not be allowed to recover these costs.[16] The assets are also at risk of being optimised out.

The effect of stranded or optimised out assets in a regulated environment is to reduce the allowed revenue base of a company. If prices are based on recovering actual costs, this would lead to excess profits being identified.

Lally recognises these risks and appears to accept that there would be a need for compensation to firms. He even suggests that this compensation could take the form of ex-post compensation, ex-ante compensation through cash-flows, or ex-ante compensation through the allowed rate of return. However, in an apparent logical contradiction, he then appears to conclude that no additional compensation should be allowed for gas pipeline businesses for these risks. This conclusion seems to be based on the following :

[15] No final guideline with regard to the asset valuation methodology has yet been provided. However it is widely assumed that the ODV valuation methodology would be proposed – this was also the case for the information request by the Commission, on which their draft control findings are based. For electricity lines businesses, the option of using a historic cost approach or an optimised replacement cost approach is left open and the vast majority of lines businesses have indicated that they would opt for the latter.

[16] The economic test in the ODV methodology would imply that the economic value only of an asset should be registered in the asset valuation.

- The gas pipeline situation would have greater similarity to the Commission's ruling on the airfields than its ruling on the electricity lines businesses, in the sense that for the airfields and the gas pipeline businesses an ex-post assessment of excess profits would be made, whereas for lines businesses it was ex-ante. For the airfields, no additional compensation was considered whereas for the lines businesses, a margin on WACC was proposed.

- The risk of stranding of assets is insignificant, because stranding is more likely to occur for dedicated assets, supplying individual customers. In these cases gas businesses would be protected by bilateral contracts, which cover stranding risks.

- The biases introduced by the asymmetric risks are slight and the use of the domestic version of the CAPM and using a high-end WACC estimate would be considered sufficient compensation.

These arguments can be challenged on a number of grounds:

Firstly, the whole argument surrounding price setting on an ex-ante or ex-post basis is fraught. Not only has the Commission not yet made it clear what form of approach it will adopt (that is also the case for electricity lines businesses), but it is highly unlikely that the eventual methodology would be as theoretically "pure" as seems to be suggested by Lally. In practice, under the regulatory regimes that we have studied, there are various ways of ex-ante and ex-post price setting. It would be highly unusual to encounter a "pure" ex-post approach, or one that only looks at past performance in setting rates going forward (allowing for compensation or penalties to account for under- or over-returns in the previous regulatory period), ignoring expected future trends. Likewise it would be unusual to encounter a "pure" ex-ante approach, one that looks forward only, ignoring past trends (still allowing for compensation or penalties). Thus, in practice, the differences between these approaches would not be as clear as suggested by Lally and they would generally not be at opposite poles of the spectrum. It is therefore not conclusive that an ex-post approach would completely remove the need for forecasting the impact of asymmetric risks, or that an ex-ante approach would provide no compensation for such risks incurred in the past.

Secondly, the Commission's approach to determining whether excess profits were made by the airfields relied on projected numbers (an ex-ante approach). At present, their assessment of excess profits for gas pipeline businesses relies on a combination of historical and projected numbers (ex-post and ex-ante).

Thirdly, the Commission is yet to specify whether they will adopt an ex-ante or ex-post approach to regulation (also for electricity lines businesses, once the thresholds are breached).

Fourthly, Lally obscures the fact that the Commission's asset valuation methodology for the airfields relied on a historic cost approach, whereas what is considered for the gas pipeline businesses is an ORC or ODV approach. The historic cost approach does not involve optimisation or stranding risk and the airfields decisions are therefore hardly relevant in this case.

Fifthly, there is no empirical basis for the sweeping generalisation about the existence of bilateral contracts that would negate the impact of stranding risks. We have provided demonstrations in the past of where whole networks have had to be strengthened for a

single, or wider customer base. In some cases this customer base has diminished at a later stage, or is anticipated to do so. In these cases bilateral contracts were not possible, or inappropriate.[17] As an energy source for large installations, gas is usually in direct competition with other sources, such as electricity or coal. Enforcing bilateral contracts that would add significant risk to the other contracting party would hardly be entertained in this environment, as it would make gas an unattractive option. In general, there is little evidence of the widespread existence of bilateral contracts that would cover utility companies against stranding risk, even where infrastructure had to be strengthened for individual customers.

Sixthly, it is noted from the information disclosed by gas pipeline businesses to the Commission, that the optimised–out value are in some cases higher than 6% of the total (pre-optimisation) asset value. This is hardly insignificant.

Seventhly, as pointed out before, the justification offered that the domestic CAPM and the suggested use of the higher end of the WACC range would provide sufficient compensation for various indirect costs, is questionable in its own right and is used in too many instances.

It is therefore clear that at the very least, the same approach should be adopted for gas pipeline and electricity lines businesses with regard to compensation for asymmetric risks. For the latter, the Commission suggested a margin over WACC of 0.15%.[18] It is not clear how this estimate was derived and it would appear to be insignificant when compared to the actual asymmetric risks faced by utilities. However, that margin at least indicated recognition of the existence of these risks and could therefore be used as a starting position.

In addition, we would argue that since the extent of optimised out assets for gas pipeline businesses is much higher than for electricity lines businesses, this margin should be much higher for gas pipeline businesses – an order of three, or 0.45%, would appear warranted.[19]

4.2 Market frictions

Real world market frictions can take a variety of forms, including funding constraints, financial distress costs, information asymmetries, and the imposition of regulation. They impose additional costs and constraints on the raising of capital that are not accounted for in the theory underlying the WACC. Overall, market- frictions do not affect the rate of return required by the market on each dollar of investment, but they do affect the value of the firm's other projects and growth opportunities and thus alter the number of dollars of investment.

[17] Refer to for example van Zijl and Verster (2003b).

[18] Par 140 in the report of the Commerce Commission titled "Regulation of Electricity Lines Businesses, Targeted Control Regime, Implementation Details, Draft Decisions", 31 January 2003.

[19] The ratio of ODV:DRC values for gas pipeline businesses, excluding transmission, is 0.94. For electricity lines businesses, this figure is 0.98. (The figure for gas transmission is even lower.)

They may impact on the overall cost of capital for the company. When a firm raises capital to invest in a project, especially if the quantum is large relative to the size of the firm, or the risk of the investment is high, this tends to influence the opportunities and cost of capital for the rest of the firm. For example:

- A firm's debt rating may fall, increasing the cost of further debt financing, even making it impossible to obtain such funding.
- By increasing gearing to recover from losses, or to provide for further investments, the increased debt exposure may impact on the firm's cost of equity. Likewise, raising further equity under distressed circumstances will require higher returns to attract new investors, which will dilute the equity value of existing shareholders.
- Firm management has greater incentive to engage in morally hazardous behaviour (i.e. "bet the house" as the downside risk is shared by debt holders whereas shareholders gain all the upside benefits).
- Firm stakeholders become reluctant to continue or extend their relationship with the firm, thereby raising the cost of these relationships.
- Firms may have to incur additional costs for redundancies, debt renegotiation and other outcomes resulting from a bad investment

Lally raises a number of counter arguments to these issues.

First, he considers the form of adjustment of prices, stating that if ex-post adjustments are made, the problem disappears. As stated before however, the Commission has yet to indicate what its approach in this regard would be. As long as the chance remains of an ex-ante or hybrid form of price adjustment, the issue has to be considered.

Second, he points out that US survey evidence on corporate use of high discount rates requires caution in extrapolation to NZ firms. While such caution is in general, appropriate, the need for caution is unlikely to be severe in this case of drawing inferences about aggregate firm behaviour. In contrast, as already pointed out above, Lally's own use of overseas data to estimate betas should be subject to extreme caution as these depend crucially on the capital markets in which the firms operate and on the regulatory regime they are subject to.

Third, Lally cites the work of external valuation advisers who do not, it seems, make any allowance for the costs associated with market frictions. The relevance of this observation is not obvious as valuers are usually concerned with estimation of a firm's market value, not the value a regulator would use to determine the existence of excess profits. More importantly, the subtlety of the market frictions argument is overlooked. When external valuers attempt to put a value on a firm, they are implicitly asking what expected return is required by investors on $1 invested in the firm's securities. But in deciding whether or not to proceed with a project, the question of relevance is: what expected return is required by investors on the specific purpose that the firm uses this dollar for? Because of phenomena such as imperfect capital markets, imperfect labour and product markets, and investment irreversibility, the answers to these two questions are not generally the same. While systematic risk may be all that matters to well diversified investors in respect of the first question, unsystematic risks generally will matter as well for the second, because

these risks increase the quantity of capital (i.e., over and above $1) used by the investment.

Lally claims that LECG (2003a) cite the evidence from Mukherjee and Hingorvani (1999) that suits their purpose, but ignores other evidence from the same paper that does not support their argument. In fact, the reference made to Mukherjee and Hingorvani (1999) included the statement: "*In addition, (Mukherjee and Hingorvani) find that internal control reasons seem to be considerably less important than the above three factors*." Therefore the LECG paper did not ignore research that supports conclusions differing from their views, but did point out that the same research indicates that there is less support for these conclusions than for those stressed by LECG.

Lally seems to accept that there is evidence of high hurdle rates in practice, but he states that this gives no insight into the appropriate size of WACC margin. In fact, the survey evidence on typical hurdle rates does exactly that, albeit in a rough fashion. In any event, it seems hard to justify his approach of setting a parameter value equal to zero simply because one does not know how far above zero it should be. Again, "use of a domestic CAPM" and the "recommendation to use a WACC estimate from the upper end of the range" are used to justify the exclusion of any other form of compensation.

4.3 Timing flexibility

When a project begins, the firm incurs an additional opportunity cost: the sacrifice of the opportunity to begin the project at some date in the future. However, the CAPM/WACC framework implicitly assumes that projects are either fully reversible or unable to be delayed. Thus, in commencing a project today, the opportunity cost is zero. But many projects are at least partly irreversible (i.e., have sunk costs)[20] and most can be delayed. For irreversible investments, the ability to delay is valuable because it allows the firm to gather more information about the project's viability, thereby minimizing the potential for losses and maximizing the potential for maximum profits. When a project begins, however, the opportunity for further delay disappears. This loss of flexibility is an additional capital cost of the project, the size of which is increasing in the specific risk of the project.

This additional capital cost manifests itself not through additional capital expenditure on the project, but rather as a reduction in the firm value (through loss of the option). Firms require additional compensation to offset this loss.

On this indirect costs associated with foregone flexibility (timing options), as well as the foregone alternative investments (discussed in the next section), Lally argues that any recognition of these factors is simply institutionalising excess profits. It is rather difficult to understand this argument, but it seems to rest on the view that only newly provided capital is a true cost of investment; the sacrifice of existing capital, by contrast, is not. This view is novel.

[20] In the gas pipeline sector, most investments are in fact irreversible. For example, pipes, valves and connection pieces have minimal salvage values, and trenches and backfilling, a major constructional cost component, have no salvage value.

We note that Lally concedes that the existence of real options, particularly growth options, would affect the asset beta.[21] However, he then states that :

"Prima facie, gas pipeline businesses do not have significant growth options."

This statement is inexplicable, especially when considering the underdeveloped state of gas networks in New Zealand, even in the large cities where such networks exist. In our experience, expansion of their networks is a key business driver for most gas pipeline businesses, with far more investment opportunities existing than could be serviced with the available capital. Optimal timing and identification of optimal investment opportunities, with the associated real options, are therefore very important in this industry.

To demonstrate the true impact of investment decisions, the concept of indirect costs can be expanded as follows.

Let $V^{project_t}$ denote the value of some new project (i.e., the future expected cashflows discounted at WACC) and I be the initial cost of this project. Similarly, let V^{firm}_{before} denote the value of the firm immediately before commencing this project (i.e., paying I and receiving $V^{project}$) and V^{firm}_{after} be the corresponding value immediately afterwards. Finally, V^{assets}_{t} is the time t value of the assets that the firm owns prior to commencing the new project. Then:

$$V^{firm}_{before} = V^{assets}_{before}$$

and

$$V^{firm}_{after} = V^{assets}_{after} + V^{project} - I$$

The change in firm value is therefore given by

$$(V^{firm}_{after} - V^{firm}_{before}) = (V^{assets}_{after} - V^{assets}_{before}) + (V^{project} - I) \qquad (13)$$

The first term on the right-side of (13) is the change in value of pre-existing assets; the second term is the project's stand-alone NPV.

Lally's approach is to focus solely on the latter term and set prices so that this is equal to zero, allowing the firm to earn exactly its WACC on the project direct cost I. But, as (13) makes obvious, this is justified if and only if $(V^{assets}_{after} - V^{assets}_{before})$ is zero. If this term were negative, then Lally's test would destroy firm value and economic efficiency would suffer.

It is helpful to re-express (13) as

[21] Lally 2004 (p 27)

$$(V^{firm}_{after} - V^{firm}_{before}) = V^{project} - \{I - (V^{assets}_{after} - V^{assets}_{before})\}$$

which makes it clear that the total cost of investment in the project is not I, but

$\{I - (V^{assets}_{after} - V^{assets}_{before})\}$.

Clearly, the correct test of economic efficiency, adopting the Commission's view, is that the economic profits to the firm (as opposed to the project) are zero (ignoring estimation error). Thus, efficient regulation should set prices so that $(V^{firm}_{after} - V^{firm}_{before})$ equals zero, thereby allowing the firm to earn WACC on its total costs of investment $(I + V^{assets}_{before} - V^{assets}_{after})$. Obviously, this is mathematically equivalent to allowing it to earn more than WACC on direct costs alone.

It is incorrect to suggest that this margin is an 'excess profit'. An excess profit occurs only if the firm expects to earn more than WACC on the total capital used by the investment, not if it expects to earn more than WACC on the new capital used by the investment. As discussed elsewhere, capital market frictions, imperfect labour and product markets, and investment irreversibility can all drive a wedge between these two capital values.

Lally further argues that the regulatory regime itself would remove the value of flexibility to gas pipeline businesses. This would indeed seem to be the case if a pure form of rate-of-return regulation is imposed. He therefore assumes that if gas pipeline businesses are, in this regulatory environment, compensated for the loss of timing flexibility, they would merely invest as soon as possible, given that the return on investment would be economically beneficial to them. There would be no mechanism to ensure that investments occur at the socially optimum point.

If this is indeed the case, we would argue that this is a serious reflection on the control regime being considered. By removing incentives to invest at the optimum point, or indeed to bring investment forward to the earliest possible point, there would be a potentially significant loss of economic efficiency, with a resulting significant loss in net public benefit. This would have to be taken into account when deciding whether control of the gas industry is in fact warranted at all.

4.4 Firm resource constraints

The CAPM/WACC framework also assumes that firms have unlimited resources. By contrast, Jagannathan and Meier (2002) point out that good firms frequently face rationing of managerial talent and organisational capital, simply because they have more desirable projects in the pipeline than they have resources available to apply to them. Consequently, commencing a project today may entail sacrificing the option on another project in the future, and this foregone opportunity is an additional capital cost of the current project. Again, the more uncertainty there is about the future project's prospects, the more valuable is the firm's option on it, and hence the greater is this additional cost.

Lally's arguments against recognising firm resource constraints are similar to that raised in section 4.3. Likewise, our counter-argument is also as stated in the same section. Once again, losing the value of the firm's option would indicate a reduction in asset value.

4.5 Quantitative assessment of the margin over WACC

One of the key arguments against allowing for a margin over the WACC to compensate firms for asymmetric effects, market imperfections or the loss of real options, is that the extent of the margin has not been conclusively demonstrated. This is a valid criticism, since it is very hard to establish with any accuracy what such a margin should be.[22] Research on this topic is currently at the cutting edge of finance theory and surveys carried out in this regard are not yet extensive or conclusive.

Ultimately, however, no matter how well-established a particular theory (such as the CAPM) might be, there comes a point where the inability of this theory to explain or square with observed practice must make one question it. This is particularly so if additional or extended theory is capable of explaining practice in a way that the original theory cannot. In the case of investment and financing decisions, we have very clear evidence that firms behave in ways that cannot be reconciled with the textbook WACC/CAPM model. Moreover, we have additional theory that explains these anomalies as being the result of indirect investment costs associated with unsystematic risks. The alternative, that firms are systematically irrational may have been in vogue amongst academics 25 years ago, but is simply not tenable today.

In summary, there may be legitimate debate about the size of these indirect costs for any given firm, but simply setting them equal to zero simply ignores both state-of-the-art academic research and business reality.

To conclude the discussion on this point, we include in Appendix II the interim conclusion reached from a study by a group of New Zealand utility companies, which include Vector and Powerco, to establish a valid theoretical basis for determining the margin over WACC.

Our recommendation, as supported by this group, is therefore that, until a firm theoretical basis is established for demonstrating the margin that should apply over the WACC, the indirect factors and regulatory risks should be compensated for by accepting the point estimate of WACC at the top end of the suggested range.

5 Asymmetric impact of setting the WACC too low

At the present stage of the gas control inquiry process, the main application of the WACC is for determining excess returns realised by gas pipeline businesses. This is a key component of the NAB test. As such, the level at which the WACC is set could be a critical component in the eventual decision whether to regulate the businesses or not.

[22] We note for example the difficulty that the Commission had in setting a margin to compensate for optimisation and stranding risk and the fact that the margin eventually decided on does not appear to be founded on any research or quantitative assessment.

In future, if regulation is indeed declared and depending on the regulatory regime adopted, the WACC will most likely remain a critical component in setting prices and determining allowable returns.

As discussed before, calculating an accurate WACC estimate (or range) is impossible. Furthermore, the uncertainty underlying the individual CAPM parameters means that any value within the estimated WACC range would be equally likely to be valid (or invalid), regardless of where it falls within the range.

On the face of it therefore, ignoring for the moment the impact of the indirect factors discussed in section 3, the Commission would be able to select a WACC estimate from anywhere within the suggested range, with no single value being less accurate than any other.

However, it is important to consider the potentially highly negative implications of setting WACC at too low a level. The impact of erring on the low side in selecting the WACC estimate, as opposed to erring on the high side is highly asymmetrical. All other factors being equal and given that the estimates within the WACC range are all equally inaccurate, this would argue for setting the WACC at the higher end of the range. Lally also recognises this (Lally (2004), section 9, p43).

We discussed the impact of too low WACC settings in some detail in earlier submissions[23], but to re-emphasise the points made, it is worth summarising the arguments again.

5.1 Insufficient compensation for investors

Basic finance theory is quite clear on the effect of too low returns on investment – if investors perceive that they are not compensated in accordance with the risk faced by their investment, they will withhold or withdraw that investment.

Rational investors would indeed require returns in accordance with what they perceive the risk of an investment to be. This perception of a fair return would not be swayed by theoretical arguments about the calculation of the WACC, but would rather be based on market perceptions. Our view of market perceptions of the factors underlying the WACC calculation is presented above and would argue for a WACC range well above that proposed by Lally.

In addition, as discussed in section 4, investors also require compensation for project-specific risks, which implies an additional margin over the WACC.

By setting the WACC at the low end of industry expectations and not sufficiently allowing for project-specific risks, we believe that investment in gas pipeline businesses will be seriously discouraged.

[23] See for example van Zijl and Verster (2003b) and Boyle (2003a)

5.2 Impact of under-investment by gas pipeline businesses

Gas pipeline businesses provide an important part of the country's infrastructure. They contribute to growth and form a cost-efficient alternative to other energy sources, especially for energy-intensive installations.

The country's gas infrastructure is still underdeveloped and large parts of even the major cities do not have access to natural gas. Any regulatory decision that could therefore inhibit investment in additional infrastructure, has the potential to significantly damage the further growth of the industry, with resulting long-term damage to the economy. It may also lead to insufficient investment in the maintenance or upgrading of installations, with resulting negative impact on service levels.

We believe that it is important that regulation should not impede gas pipeline businesses from investing to maintain and expand services consistent with consumer demand and that the Commission's WACC estimate for (potentially) regulating these businesses should allow for this.

5.3 Asymmetrical impact of under and over investment

In general, under investment in infrastructure is likely to have significantly higher economic cost than over-investment. The main reason for this is that modest over-investment will typically lead to slightly higher prices than otherwise, but the consumer is able to access the desired service. Given the relatively low price elasticity of demand, such small price increases are not likely to have a significant impact on consumer choices. In addition, in a growth environment, the negative effects of over-investment are also continually diluted.

Under investment on the other hand, will lead to the downgrading of services and lack of network growth, as described in section 5.2.

In economic terms, under investment leads to the loss of the entire consumer and producer surplus associated with the output shortfall. In contrast, slight over-investment is equivalent to providing higher quality service than consumers demand, and hence the only economic loss is that associated with the difference between the consumer valuation of the higher service level and its opportunity cost.

The need to ration firm resources suggests a further reason for this view. If the Commission sets the allowed rate of return too low, projects are unprofitable and the firm chooses not to invest, with all the attendant social costs. But if the rate is set too high, thereby encouraging the firm to undertake wasteful investment, its attempts to do so are constrained by the quantity of organisational, physical, and managerial resources it has available. So long as it allocates these resources to the highest-yielding projects, the amount of wasteful investment is limited. As a result, setting the cost of capital too low creates greater economic costs than does setting it too high.

Even in the absence of resource constraints, the economic costs of the two types of regulatory error can still be asymmetric due to the non-linear consequences of irreversibility. Evans and Guthrie (2003) develop a model of the optimal investment timing policy for a regulated firm and show that setting the allowed rate of return too high increases investment in only a minor way, but that too low a rate can significantly

delay investment. In other words, potential under-investment is more severe than potential over-investment.

6 Using WACC to determine excess profits over short periods

A very important aspect raised in Boyle (2003a) and van Zijl and Verster (2003a) (2003b) which have been ignored by Lally, is the difficulties that exist with the manner in which the Commission intends to use the WACC to determine excess returns.

The Commission proposes to express its pricing principles over the medium term[24], so that short-term fluctuations do not distort judgements. It is important that any comparison of a theoretical rate of return with the actual return reflect recognition of the uncertain nature of the comparison. Rate of return is a stochastic variable. That is, if a firm was to set itself the objective of earning a target rate of return (equal to *WACC* plus an appropriate margin), it could expect to achieve the target rate only on average. In any particular year, random factors can combine to result in a realised rate of return that differs markedly from the target.

The Commission's task is to differentiate between a realised rate that differs from an acceptable target rate due to random factors and a realised rate that differs because the firm is operating with the objective of exceeding that target rate. Ex-post profits are a very noisy indicator of ex-ante monopoly profits. To be reasonably confident that monopoly profits are being earned, and that the firm should therefore be subject to control, the realised ex-post profits would have to be very high indeed. In other words, there would have to be evidence not simply of excess profits, but of 'super'-excess profits. It would be very difficult on the basis of 5 or less years of evidence on realised rates to reject the assumption that a firm is aiming to earn an acceptable target rate of return.

6.1 Controlling excess profits

Some caution is required with the control process - it leaves the firm exposed to considerable residual risk.

In particular, the application of a revenue ceiling has a highly asymmetrical effect on the revenue stream. While it is true that any revenue upside is effectively eliminated by control, compensation for downwards movements is more problematic.

- There is a significant time delay before gas pipeline companies can adjust prices to compensate for downwards market movements. Frequent price resetting is not only impractical, but likely to be highly unpopular with customers. Opportunities for such price resetting are therefore relatively few and far between.

- There is a significant lag before the impact of changing consumption patterns on revenue can be accurately assessed and prices then be adjusted to compensate for such movements.

[24] Actual term not known, but Lally suggests a three-year period

- In spite of the relatively low price-elasticity in demand for gas, imposing higher prices, to compensate for lower gas consumption, will simply put further downward pressure on consumption.

- A pipeline business has no ability to retrospectively recover earlier lost income, due to lower consumption rates or from setting prices at levels not providing adequate returns on its asset base.

For these reasons, regulation of the form proposed to apply to New Zealand gas pipeline businesses is likely to be far more successful at placing a ceiling on earnings than providing a floor.

6.2 The NPV=0 test

We allude above to the difficulty of inferring ex-ante NPV > 0 from observations that ex-post NPV > 0. Perhaps even more fundamental is whether NPV = 0 is a reasonable test of efficiency even on an ex ante basis. To see why it may not be, consider the following example taken from Stulz (1999).

A firm has equity with a market value of $120m and cash holdings of $110m. Suppose that this firm is offered a gamble that takes the following form. By accepting the gamble, the firm agrees that a coin is flipped immediately. If the coin comes up heads, the firm receives a cheque for $102m. The cheque is already written, so there is no uncertainty about whether the firm will receive that amount of cash. If the coin comes up tails, the firm has to write a cheque for $100m, so that most of its cash holdings disappear. Assuming that cash was valued dollar for dollar in the firm's equity, if the coin comes up tails, the value of equity falls to $20m. Since the gamble takes one second to reveal its payoff, its payoff has no systematic risk and the time value is essentially zero. Hence, its net present value is simply the expected payoff, which here is $1m. According to the NPV = 0 rule, this gamble offers excess profits and should be accepted forthwith. Yet, as Stulz puts it:

"I would be amazed if one could find a firm ... that would take (such a gamble)..."

But if firms don't take such gambles, then the NPV = 0 criterion cannot be an indicator of excess profits.

There are two main reasons why firms don't take such gambles. First, uncertainties about the parameters involved in estimating NPV mean that firms will need estimated NPV to be sufficiently high to counter estimation error. Second, and more importantly, the existence of indirect investment costs mean that expected profits must be sufficiently high to cover these as well, i.e., NPV > C for some indirect costs C.

All of the above would argue that using the WACC in a rate-of-return or building-block regulatory environment is inappropriate, unless very long regulatory periods are considered. This in turn has its own difficulties, among which are the increased uncertainty of forecasting and price-setting, additional systematic risk for companies and the inability to respond to market changes in the short term. This leaves the Commission with a difficult situation and in practise it may be necessary to allow far higher profit levels than that indicated by using the WACC, before intervention is warranted.

7 Conclusion

The key messages from this report are :

- There is huge uncertainty surrounding the parameters on which the CAPM, and hence the WACC is based. In fact the only reason why we support the use of the CAPM, is the absence of an alternative model that does not suffer from the same informational shortcomings or offers a better indication of returns.

- Any attempt to come up with a narrowly defined band of WACC estimates based on the CAPM is by definition bound to be inaccurate. Furthermore, once a reasonable band of WACC estimates has been established, any value within this range is equally valid (or rather, prone to the same degree of error).

- Even if the WACC range has been set at a realistic level, investors do not accept projects if the NPV = 0. In other words, they use a hurdle rate higher than the WACC for investment decisions. This is because they require additional compensation for a variety of indirect costs, including the effect of asset optimisation and stranding, the cost of financial distress and other market imperfections and the loss of flexibility and other real options once projects proceed.

- Setting the WACC too low would have a highly detrimental effect on economic efficiency. This would lead to under-investment in gas infrastructure and a lack of growth of gas pipeline networks. In turn, this will have wider economic repercussions, especially on energy-intensive installations.

- Using WACC in a regulatory environment to determine excess profits is fraught with difficulty. In practice it is only possible to observe ex-post profits, while the WACC is a predictive indicator. Short-term fluctuations in returns are inevitable and only on average would an annual return (or series of returns) approximate a value that can be reasonably compared with the WACC.

From a practical perspective, applying the Commission's approach to calculating the WACC but correcting the values of the underlying parameters as discussed, the suggested WACC range is 8.3% to 11.2 %.

Given the huge uncertainty implicit to the WACC calculations, the likelihood of errors in its estimation, and the asymmetric impact that setting the WACC too low would have, in deciding on a point value for the WACC it is important to select this from the high end of the range. Adopting the Commission's approach and setting the WACC at the 75th percentile of the range, this would result in a point estimate of 10.5%.

Finally, although we are not in a position to provide conclusive evidence or calculations for what the margin over WACC should be to compensate investors for the indirect and regulatory risks discussed, these risks clearly exist and it is inappropriate to assume that the margin is zero. This implies that the point estimate for WACC should be taken from a position higher than the 75th percentile of the suggested range.

Based on the Commission's view for the stranding and optimisation risks faced by electricity lines business, adapted for the greater risks faced by gas pipeline businesses, a

an additional margin of 0.45% would be appropriate. On top of this, provision has to be made for the indirect risks.

This would suggest a WACC point estimate in excess of the range suggested, but in the absence of formal proof, we suggest that the top end of the range is adopted, or 11.2%.

This may still understate the actual hurdle rate for gas pipeline businesses, but would go a significant way to avoiding the impact of setting the WACC too low and also increase the threshold before profits are deemed to be excessive.

Appendix I : Qualifications and Experience

Professor Glenn Boyle

Director

Glenn Boyle provides consulting services in real options analysis and other finance-related issues, and offers advice to a variety of government and commercial organisations.

He is currently Executive Director of the NZ Institute for the Study of Competition and Regulation. Previously, he was Professor of Finance in the University of Otago's School of Business, and was a member of the Advisory Board to the Debt Management Office of the New Zealand Treasury between 1995 and 2001. Professor Boyle's current research interests include real options theory, executive compensation, and financial market anomalies. He serves on the editorial board of three international journals and has published extensively.

Professor Boyle holds a PhD in Finance from the University of Texas and a Master of Arts (first-class Honours) in Economics from the University of Canterbury. His PhD thesis focused on general equilibrium asset pricing models, a topic on which he has published papers in the *American Economic Review, Journal of Political Economy, Journal of Finance,* and *Journal of Financial Economics*, among others.

Professor Tony van Zijl

Director

Tony van Zijl provides consulting advice and litigation support in financial reporting, financial management, capital markets, cost of capital and valuation. He has given expert evidence on these matters in High Court proceedings and arbitrations.

He is Professor of Accounting and Financial Management at Victoria University of Wellington.

Professor van Zijl is a member of the Valuation and Property Standards Board of the New Zealand Property Institute. He was a foundation member of the Accounting Standards Review Board and is a former Chairman of the Financial Reporting Standards Board. He is also a former New Zealand President of the Accounting and Finance Association of Australia and New Zealand.

He has served on government working parties on securities law reform, capital charging for tertiary education institutions, and value-based reporting for state-owned enterprises. He is a member of the Institute of Finance Professionals of New Zealand (Certified Securities Analyst Professional) and of the Institute of Chartered Accountants of New Zealand (Fellow Chartered Accountant).

Professor van Zijl holds a PhD in Finance, a Diploma in Accounting, and Bachelor's degrees in Economics (Honours) and Mathematics, all from Victoria University of Wellington. His PhD thesis dealt with theoretical aspects of the Capital Asset Pricing Model.

Ryno Verster

Managing Consultant

Ryno Verster specialises in the analysis of organisational structure and strategy, and on the development of complex financial models, with a special focus on intangible assets. He provides strategic and financial advice to a broad range of industry clients in New Zealand and Australia, and has been extensively involved in the determination of royalty rates, drafting of transfer pricing agreements, and the identification and valuation of intangible assets.

With a solid background in engineering and project management, prior to embarking on his finance career Ryno managed major multi-disciplinary construction projects for Auckland's electricity distributor, from concept stage to hand-over. He also founded and managed a highly successful consulting engineering company, providing the electricity industry in South Africa with services in design and project management, regulatory issues, specialist advice and tariff structures.

Ryno holds a Master of Electrical Engineering from the University of Stellenbosch (South Africa) and an MBA from the University of Otago.

Appendix II : Findings on margin over WACC

1. In past submissions to the Commerce Commission, the argument for the recognition of an additional margin that should be applied to the weighted average cost of capital (WACC) for companies has been presented in some detail. For example :

   a) Boyle (2002) [25] and (2003)[26], argued that the Capital Asset Pricing Model (CAPM) on which the determination of the WACC relies, does not adequately describe the cross-sectional variation in stock returns and that it fails to adequately account for potentially important sources of risk. He demonstrated that CAPM-based WACC estimates are subject to considerable error. Furthermore, he discussed three major costs to investment that are not present in the CAPM, but are nevertheless real – the existence of market frictions; irreversibility of investments and the loss of timing flexibility; and constraints on firm resources. He also provided a review of the existing literature around the existence of a margin over the WACC.

   b) van Zijl (2003)[27] describes the need to consider a margin over the conventional WACC to compensate for certain non-systematic risks. These risks increase the number of units of capital required for a project/investment, rather than increase the cost per unit of capital (which depends only on systematic risk factors), but the overall impact is the same. Particular risks that fall in this category are the optimisation and stranding risk that some forms of regulation give rise to; real world market frictions; the impact of information asymmetries; additional risks posed by the regulation of the market; and the fact that markets are dynamic, rather than static as assumed by the CAPM.

   c) Emanuel (2003a) [28] also described the large uncertainty and scope for error that is implicit in the CAPM and therefore the conventional determination of

[25] Boyle, G., 2002, Corporate Investment Policy : What is the Cost of Capital?, Telecom submission to the Commerce Commission on the TSPO Discussion Paper and Practice Note – Implementation Issues Paper.

[26] Boyle, G., 2003 (Sept), Some thoughts on the cost of capital proposed for the Regulation of Electricity Lines Businesses, LECG. (Prepared for Powerco Ltd.)

[27] van Zijl, T. and Verster, R., 2003 (Sept), Review of the Weighted Average Cost of Capital as proposed for the Regulation of Electricity Lines Businesses, LECG. (Prepared for Orion Ltd)

[28] Emanuel, D. 2003a, Statement of David Munroe Emanuel, Part of Powerco's submission to the Commerce Commission in response to its Draft Decision Papers of 23 December 2002 and 31 January 2003, 9pp.

the WACC. In Emanuel (2003b)[29] he further discusses the need for a margin over the WACC and concludes that this margin should be at least 3%.

2. International survey evidence suggests overwhelmingly that companies apply a higher hurdle rate to investment decisions than that indicated by their base WACC.[30]

3. While it is therefore widely held that a margin should be added to the conventionally calculated WACC when it is used for investment, and hence regulatory purposes, it has traditionally been very difficult to attach a figure to this. The Commission has therefore been reluctant to apply a margin over the WACC range recommended by their expert advisor, Associate Professor Martin Lally.

4. To address this situation, [*utility name*] is part-sponsoring a study that aims to provide a theoretical basis for the calculation of the company-specific margin that should be applied over the WACC in a dynamic market-environment. The study is still in progress, and is currently undergoing refinements to the underlying theory and mathematical model. Preliminary results from the study, which was limited in the non-systematic risks considered, support the view that a substantial margin over the WACC would indeed be appropriate for practical investment decisions.[31] While the study and its associated model are not yet ready for peer review, the initial results are encouraging and we expect that it will eventually provide a solid theoretical basis from which a realistic, company-specific margin over the WACC can be determined.

5. We believe that the arguments and evidence prepared by various experts, observation of actual investment practice, the findings described in the available literature, and the preliminary results from the study we are co-sponsoring, all provide strong support for the application of a margin over WACC. While the ballpark figure for such a margin appears to be around 3% to 4%,[32] this has however not been formally demonstrated yet.

6. Recognising the difficulty in determining what its magnitude should be, we accept that the Commission is unlikely to apply a margin over the WACC if the number is not based on sound theoretical proof or verifiable empirical data. However, ignoring this margin in the interim would have a detrimental effect on investment incentives in a period where high levels of investment are

[29] Emanuel, D. 2003b, Weighted Average Cost of Capital – Section of Powerco's Cross-submission on the Commerce Commissions' Conference March 2003: Regulation of Electricity Lines businesses Thresholds and Control, 6pp.

[30] Refer to, for example, Poterba, J. and L. Summers, 1995, A CEO survey of US companies' time horizons and hurdle rates, Sloan Management Review, 43-53 and Mukherjee, T. and V. Hingorani, 1999, Capital-rationing decisions of Fortune 500 firms, Financial Practice and Education, 7-15.

[31] Hypothetical company data, based on typical profit rates and volatility in income experienced by New Zealand utility companies, indicate margins of between 0.9 % and 6.5% over the WACC.

[32] We note that, per definition this margin, as well as the underlying cost of capital, should be company-specific, but accept that an industry average may be appropriate for benchmarking purposes.

required. In the interim, this problem can at least be partially alleviated by using the high end of the Commission's estimated WACC range when deciding on a final WACC figure. This would be in accordance with Lally's own advice about applying the suggested WACC range, and would go some way in recognising companies' requirement for compensation for market imperfections, and the uncertain and incomplete nature of the CAPM and WACC calculations.

7. It should be clearly recognised that this would be an interim measure only, while the formal proof of the actual magnitude of a margin over the WACC is still being pursued.

8. We therefore recommend that, in deciding on the WACC figures to be used for regulatory purposes, the Commission initially use the top end of the suggested WACC range. When, in future, the actual magnitude of the appropriate margin that should be applied over the WACC can be reliably demonstrated, the figure used by the Commission should be revisited.

References

Boyle, G., 'Some thoughts on the cost of capital proposed for the regulation of electricity lines businesses', prepared on behalf of Powerco Ltd, LECG, 15 Sep 2003a, 21pp.

Boyle, G., 'Derivation of WACC Margins', prepared on behalf of NGC Holdings Ltd, LECG, 19 Sep 2003b.

Campbell, J., 'A Variance Decomposition for Stock Returns', Economic Journal, 101, March 1991, 157-179.

Campbell, J. and J. Mei, 'Where do Betas Come from? Asset Price Dynamics and the Sources of Systematic Risk', Review of Financial Studies' 6, 1993, 567-592.

Cornell, B., 'Risk, duration, and capital budgeting: New evidence on some old questions', *Journal of Business*, vol 72, 1999, 183-200.

Dimson, E., Marsh, P. and M. Staunton, 'Triumph of the Optimists - 101 Years of Global Investment Returns', Princeton University Press, 2002.

_____ , 'Global Evidence on the Equity Risk Premium', Journal of Applied Corporate Finance, 15, Fall 2003, 27-38..

Evans, L. and G. Guthrie, 'Risk, Price Regulation, and Irreversible Investment', ISCR, Dec 2003, 15p.

_____, 'Incentive Regulation of Prices when Costs are Sunk', ISCR, May 2004, 25p.

Ferguson, M. and R. Shockley, 'Equilibrium Anomalies', *The Journal of Finance*, vol 57, 2003, 2549-2580.

Huang, C. and R. Litzenberger, Foundations for Financial Economics, North-Holland, New York, 1988.

Jagannathan, R. and I. Meier, 'Do we need CAPM for capital budgeting?', *Financial Management,* vol 31, 2002, 55-77.

Lally, M., 'The weighted average cost of capital for electricity lines businesses', paper prepared for the New Zealand Commerce Commission, 2003.

_____, 'The weighted average cost of capital for gas pipeline businesses', paper prepared for the New Zealand Commerce Commission, 14 May 2004, 74pp.

Roll, R., 'A Critique of the Asset Pricing Theory's Tests', *Journal of Financial Economics*, 4, March 1977, 129-176.

Roll, R., and S. Ross, 'On the Cross-Sectional Relation Between Expected Returns and Betas', *Journal of Finance*, March 1994, 101-121.

Stulz, R., 'What's wrong with modern capital budgeting'. Financial Practice and Education, 9, 1999, 7-11.

van Zijl T., 'Review of the Commerce Commission's estimate of WACC for the Telecommunication Service Obligation', prepared on behalf of Infratil Ltd, Vector Ltd and New Zealand Exchange Ltd, LECG, Jul 2003, 9pp.

van Zijl T. and R. Verster, 'Response to the Commerce Commission's Gas Control Inquiry Draft Framework Paper : Estimation of the Weighted Average Cost of Capital', prepared on behalf of NGC Holdings Ltd, LECG, Aug 2003a, 28pp.

van Zijl, T. and R. Verster, 'Review of the Weighted Average Cost of Capital as proposed for the Regulation of Electricity Lines Businesses', prepared on behalf of Orion Ltd, LECG, Sep 2003b, 17pp.