REVIEW OF THE WACC IN TRANSPOWER'S FORMAL SETTLEMENT PROPOSAL

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EXECUTIVE SUMMARY

The Commerce Commission has recently issued notice of its intention to declare control of Transpower. In response to this, Transpower submitted a Formal Settlement Proposal. Inter alia, this proposal specified a methodology for determining Transpower's WACC along with an estimate of it. Subsequently, Transpower submitted three further Formal Settlement Proposals. This paper has reviewed the WACC aspects of the first, third and fourth proposals, and the conclusions are as follows.

Transpower's first Formal Settlement Proposal (August 2006) covered a five year term with annual resetting of the WACC value. The WACC model proposed matched that favoured by the Commission, along with use of the ten-year risk free rate, a corporate tax rate of .33, an asset beta of .35, leverage of .45, a market risk premium of .075, an estimate for the tax parameter T of .198, and a debt margin of .01. In conjunction with the risk free rate prevailing at the time of the proposal, these parameter values implied a WACC estimate of .072.

Of these parameter values, the corporate tax rate is uncontroversial, and consistency with previous analysis requires a market risk premium of .07, an estimate for T of .33, and leverage of .40. In respect of the risk free rate, previous analysis supports the choice of a term that matches the frequency with which changes in the rate are made; consequently, the use of the one year rather than the ten-year risk free rate is appropriate. In respect of the debt premium, Transpower is differentiated from the other New Zealand electricity lines businesses by its government ownership and its involvement in transmission rather than distribution. The ownership issue should be irrelevant to assessing its cost of debt for the purposes of setting output prices, and its involvement in transmission rather than distribution would appear to exert only a trivial impact upon the debt premium. Accordingly, an appropriate estimate for Transpower's debt premium is that derived earlier for privately-owned New Zealand electricity distribution businesses, of .01 at leverage of .40. In respect of the asset beta, the regulatory regime implied by Transpower's proposal resembles that for US electric and gas utilities. Some differences are identified, and these differences suggest that the upper bound on the estimated asset beta is that for the US firms, for

which an estimate of .30 is appropriate. Using this upper bound on the estimate of the asset beta, along with the estimates for the remaining parameters and the one-year risk free rate prevailing in August 2006, the estimated WACC for Transpower is .071. In addition, the standard deviation on the estimate is .011.

Had the WACC been fixed for four years rather than one year, and the regime was otherwise identical to that in Transpower's proposal, then the appropriate risk free rate to use would be that for four years rather than one year, and the upper bound on the asset beta would rise from .30 to .375. Also, if the WACC was fixed for five years rather than one year, and the regime was otherwise identical to that in Transpower's proposal, then the appropriate risk free rate to use would be that for five years rather than one year, and the upper bound on the asset beta would rise from .30 to .40.

Transpower's third Formal Settlement Proposal (May 2007) differed from the initial proposal in five respects. Firstly, the asset beta was raised from .35 to .40. However, this proposed change is not consistent with the annual resetting of WACC that was also envisaged in this proposal. Secondly, Transpower's estimates for leverage, the market risk premium and the tax parameter T are now .40, .07 and .33 respectively, consistent with those favoured here. Thirdly, Transpower proposes a margin of .001 on the point estimate of .073, to yield their proposed figure of .074. Although the rationale for this margin is not articulated, I agree with the general principle of a margin to deal with uncertainty over the WACC estimate. Fourthly, Transpower's proposal to reduce the company tax rate used in determining the tax deduction on interest within WACC to .30 (from 1.4.2008) is correct. However, there are further implications of this tax change for the cost of equity, and consideration of these further effects suggests that the tax parameter T within the cost of equity should also be reduced to .30 from 1.4.2008. Fifthly, Transpower's suggestion that this tax parameter T be reduced accords with the conclusion just stated.

Transpower's final Formal Settlement Proposal (August 2007) differs from its predecessor in that it would apply to a four rather than to a five year term (from 1.7.2007), the WACC would be set for the entire four years rather than be subject to annual revision, and a separate WACC would apply to the one year term preceding 1.7.2007. Taking account of the relevant risk free rates, and the upward adjustment to

WACC arising from the announced decrease in the corporate tax rate, Transpower has proposed figures of .072 for the one year period, .077 for the first year of the four year term, and .078 for the remaining years in the four year term. This paper favours a market risk premium of .07, leverage of .40, a debt risk premium of .01, and a risk free rate whose term matches the period for which the WACC is fixed. In addition, the corporate tax rate should be .33 until 1.4.2008 and .30 thereafter, and the value for the tax parameter *T* should match this. Finally, as discussed above, the upper bounds on the asset betas for the one and four year periods should be .30 and .375 respectively. Using these parameter values, the point estimates for WACC should be .071 for the one year period (with a standard deviation on the estimate of .011), .078 for the four year period until the corporate tax rate falls on 1.4.2008 (with a standard deviation on the estimate of .012), and .080 thereafter (with a standard deviation on the point estimate of .012).

1. Introduction

The Commerce Commission has recently issued notice of its intention to declare control of Transpower (Commerce Commission, 2006a). In response to this, Transpower (2006a) submitted a Formal Settlement Proposal. Inter alia, this proposal specified a methodology for determining Transpower's WACC along with an estimate of it. Subsequently, Transpower submitted three further Formal Settlement Proposals (Transpower, 2006c, 2007a, 2007c). This paper seeks to review the WACC aspects of the first, third and final proposals, corresponding to Transpower (2006a), (2007a) and (2007c).

2. Transpower's Initial WACC Proposal

Transpower's (2006a) initial proposal covered a term of five years, with WACC estimated as follows

$$WACC = k_e(1-L) + k_d(1-T_c)L \tag{1}$$

where k_e is the cost of equity capital, k_d is the cost of debt capital, L is leverage and T_c is the corporate tax rate. The cost of debt is as follows

$$k_d = R_f + p \tag{2}$$

where p is the premium over the risk free rate. The cost of equity is determined as follows

$$k_e = R_f(1-T) + DT_d + \phi\beta_e$$

where R_f is the ten year risk free rate, D is the firm's cash dividend yield, T is a parameter that reflects the average tax rate on interest relative to that on capital gains, T_d is a parameter that reflects the average tax rate on cash dividends relative to that on capital gains, ϕ is the market risk premium in this version of the CAPM, and β_e is the equity beta. However, Transpower's dividend yield is zero and therefore the formula for the cost of equity reduces to the following.

$$k_e = R_f(1-T) + \phi\beta_e \tag{3}$$

Finally, the equity beta can be decomposed as follows

$$\beta_e = \beta_a\left[1+\frac{L}{1-L}\right] \tag{4}$$

where β_a is the asset beta. These equations (1), (2), (3) and (4) are identical with those invoked by the Commission in estimating the cost of capital. In addition, Transpower proposed resetting the WACC annually using the prevailing ten year risk free rate. The parameter values favoured by Transpower were L = .45, T_c = .33, R_f = .057, ρ = .01, T = .198, ϕ = .075 and β_a = .35. Insertion into these equations generated an estimated WACC of .072.

3. Analysis of the Initial Proposal

3.1 Introduction

Of the parameters discussed above, ϕ, T_c and T are applicable to all firms. Consistency with previous analysis (Lally, 2006) requires that the same estimates of .07, .33 and .33 respectively be adopted. Furthermore, and in respect of the risk free rate, previous analysis (Lally, 2006) argues for a term that matches the frequency with which changes in the rate are recognised, and for estimating the rate using the average over the preceding month (Lally, 2006, section 4)[1]. In Transpower's proposal, the risk free rate is intended to be reset annually. Accordingly, the appropriate rate is the one year rate. Averaged over August 2006, this figure is .0713.[2] This leaves three remaining parameters to assess, i.e., L, ρ and β_a. In addition, and following Lally (2006, section 9.1), the standard deviation on the WACC estimate is derived.

3.2 Leverage

[1] The analysis in Lally (2006) refers to the frequency with which output prices are reset. However, for the purpose of choosing the term of the risk free rate to be used in setting output prices, the significant aspect of the resetting process is the frequency with which changes in the risk free rate are recognised.

[2] The Reserve Bank of New Zealand reports a figure of 7.01% (www.rbnz.govt.nz), which arises from a semi-annual rate of .03505 along with annualisation using simple-interest. However, the appropriate annualisation process involves compounding, and this gives rise to an annualised figure of 7.13%.

In respect of leverage, the possible measures include actual leverage, optimal leverage as assessed by the regulator, and the firm's target leverage. In the present context, in which the Commission effectively assesses an appropriate output price for Transpower, the choice must lie between the first two. If actual costs are utilised in this process, then consistency suggests that Transpower's actual leverage level should be invoked (in so far as it can be observed). By contrast, if efficient costs are utilised in this process, then consistency suggests the use of optimal leverage as assessed by the regulator. Whichever is applied should be measured in market value terms, as discussed in Lally (2006, Appendix 5).

Two considerations favour the use of optimal leverage over actual leverage in this particular case, and also favour assessing optimal leverage by reference to the average leverage employed across a set of firms in the same industry. Firstly, even if actual leverage were desired (consistent with the use of actual costs), any assessment of actual leverage is complicated by the possibility of future cross-border leases (Transpower, 2006a, p 9, alludes to this possibility). Such (financing) leases are de facto debt, these must then be included in an estimation of its leverage, and this complicates what would otherwise be a straightforward estimation process. By contrast, an assessment of optimal leverage (by consideration of the actual leverages of a number of companies) circumvents this difficulty simply through the exclusion of firms with unusual financing arrangements from any such analysis. Secondly, there is some evidence that the leverage levels of firms reflect the random outcomes of past investment decisions as well as assessments of what is currently "optimal"; this is generally referred to as "pecking order theory" (Myers, 1984; Titman and Wessels, 1988). This argues against the use of actual leverage as an indicator of optimal leverage for a particular firm, and points to the merits of averaging over the observed levels of a number of firms within the relevant industry. In light of all this, I favour the use of optimal leverage as determined by examination of a set of comparable companies.[3] As discussed in Lally (2006, section 6), an appropriate estimate for the

[3] A further potential consideration lies in the fact that Transpower is not a listed company, and therefore its (market value) leverage cannot be directly assessed. However, as discussed in Lally (2006, Appendix 5), the effect of an administrative settlement would be to induce a market value for the firm that would approximate its book value. Consequently, book value leverage would be a good proxy for market value leverage.

optimal leverage of New Zealand electricity lines businesses is .40. This is close to Transpower's proposed value of .45.

Transpower (2006b, pp. 8-10) argues that there are uncertainties in assessing optimal leverage. Accordingly, a range should be specified and Transpower's actual leverage adopted if it falls within that range. However, uncertainty in assessing optimal leverage is part of the broader problem of assessing parameters, and the solution proposed to this is the estimation of a standard deviation on WACC along with selection of a WACC value from above the 50^{th} percentile of the distribution of possible WACC values. This process, which is described in section 3.7, incorporates allowance for uncertainties in estimating optimal leverage. In view of this proposal, Transpower's argument is superseded. Transpower (2006b, pp. 8-10) also argues that its capital structure is sufficiently uncomplicated that there are no obstacles to assessing its actual leverage. However, the complication is contingent upon Transpower's future adoption of financing leases rather than one that arises out of its present financing arrangements.

3.3 The Debt Premium

In respect of the debt risk premium, this will depend upon the leverage level. In respect of electricity lines businesses, Lally (2006, section 7) argues for a premium of .01 at a leverage level of .40. However, the empirical evidence on debt margins for the New Zealand electricity lines businesses that is presented in Lally (ibid, Table 4) points to a lower premium for Transpower than for other lines businesses. The explanation for this is likely to lie in Transpower's public ownership, and (possibly) its involvement in transmission rather than distribution. We consider both of these possibilities.[4]

In respect of the ownership issue, publicly owned entities have a lower risk of default, because their owners are more likely to rescue the entity in the event of financial difficulties, and this induces a lower cost of debt. To explore this issue, consider the following highly simplified example. An electricity transmission industry is

[4] In addition, commercial orientation and size might induce a lower cost of debt for Transpower than the smaller trust-owned lines businesses. However, since data on firms of the latter type does not appear in Lally (2006, Table 4), these additional factors require no consideration here.

characterised by two types of firms. Type A firms are publicly owned, have no risk of default and can therefore borrow at the government stock rate of 6%. In addition, such firms are fully debt funded so that their cost of capital is 6%. All such firms have assets of $1,000m and no other costs. So, an appropriate level of revenues would appear to be $60m per year for each firm. Type B firms are identical except in being privately owned, and therefore at some risk of default. The probability of default is 1% and losses suffered by debt holders in that event would be the full $1,000m invested. Accordingly, the cost of debt for such firms is 7% per year, with the additional 1% (i.e., $10m per year) compensating debt holders for the expected default loss of $10m per year. Since type B firms are also fully debt funded, their cost of capital is 7% per year, and therefore the appropriate revenues are $70m per year for each firm.

For the purpose of setting output prices, the cost of debt of these firms could be assessed by averaging over the rates for the two types of firms, applying different rates depending upon ownership, or applying the private sector rate to all firms. The first policy, involving an average rate, is not viable because it will apply a rate that is too low to private sector firms. For example, if the average rate is 6.4%, then the revenues obtained by private-sector firms will be only $64m per year whereas their interest costs are $70m per year. The firms will therefore be rapidly driven into bankruptcy, i.e., the revenues in even the first year will be insufficient to meet the interest payments required by debt holders. Furthermore, if more of the firms in this industry become publicly owned, the average cost of debt will decline and thereby aggravate the problem here.

The second policy, involving a 6% cost of debt for the publicly-owned firms, generates more subtle problems. To examine this matter more closely, suppose that a distress situation occurs for a publicly-owned firm, i.e., the business suffers a shock that reduces the value of its assets by $1,000m and the taxpayer owners inject this sum to restore the business to its former condition. The owners may or may not seek to recover this $1,000m by raising the firm's output prices. If they do seek recovery in this way, then the cost of debt that should be used to determine the firm's output price is no longer 6%. It is instead 6% in tranquil times and something considerably larger in the event of financial distress. To set the output price initially on the basis of

a 6% cost of debt, but with the possibility of a subsequent substantial increase under certain conditions, raises significant problems of inter-generational equity. To avoid such difficulties, the appropriate course of action would be to act as if the publicly-owned firms were privately owned and therefore faced the private sector cost of debt of 7%. On the other hand, if the owners of a publicly owned firm would not seek to recover the $1,000m through higher prices in the event of financial distress, then the inter-generational equity problem still exists but is instead suffered by the taxpayer owners of the firm rather than its customers, i.e., taxpayers who live through a period without financial distress will not be required to contribute to the $1,000m whereas those who do live through it will be required to do so. In view of this, the appropriate course of action would still be to avoid the inter-generational equity problem, and this can only be done through setting output prices to incorporate the future possibility of financial distress, i.e., to act as if the publicly-owned firms were privately owned and therefore faced the private sector cost of debt of 7%.

In summary, three possible methods for setting the cost of debt for electricity transmission businesses exist. The first option will undermine the financial viability of privately owned firms through an insufficiently high cost of debt. The second option induces inter-generational equity problems for either the customers or the owners of the publicly owned firms. The third option is free of both problems, and is therefore recommended, i.e., apply the private sector cost of debt to all firms in the industry.

Turning now to the second possible explanation for Transpower's lower cost of debt, Lally (2006, Appendix 6) compiles S&P credit ratings and other information for a number of Australian electricity transmitters and distributors, and derives the following regression model from this data

$$RAT = -0.69 + 4.56OWN + 0.47BUS + .035LEV \qquad (5)$$

where RAT is the S&P rating for the firm (1 for AA+, 2 for AA, etc), OWN indicates whether the entity is publicly or privately owned (1 for private and 0 for government ownership), BUS indicates whether it is a transmission or a distribution company (1 for distribution and 0 for transmission), and LEV indicates its book value leverage.

Thus, the predicted reduction in credit rating for a transmission business relative to a distribution business is 0.47, i.e., approximately half of one rating shift. The Essential Services Commission (2005, Tables 9.12 and 9.13) reports premiums on Australian firms sourced from CBA Spectrum and Bloomberg, for ratings from A+ to BBB+ and terms from four to ten years. In respect of the CBA data, the debt premium averages 0.63% for A+ bonds and 0.86% for BBB+ bonds, implying an increment to the debt premium of about .05% per rating shift. For the Bloomberg data, the result calculated in the same way is .04% per rating shift. So, the predicted reduction in the cost of debt for a transmission business relative to a distribution business is about .02%. This is inconsequential.

In summary, Transpower differs from other New Zealand electricity lines businesses through its government ownership and its involvement in transmission rather than distribution. The ownership issue should be irrelevant to assessing its cost of debt for the purposes of setting output prices, and its involvement in transmission rather than distribution would appear to exert only a trivial impact upon the debt premium. Accordingly, an appropriate estimate for Transpower's debt premium is that derived in Lally (2006, section 7) for privately-owned New Zealand electricity distribution businesses, i.e., a premium of .01 at leverage of .40. This matches Transpower's proposed value.

3.4 Asset Beta

Lally (2006, section 5) estimates the asset beta for New Zealand electricity lines businesses subject to five-year price and quality thresholds at .40. This estimate comprises an estimate of .30 for US electric and gas utilities subject to "rate-of-return regulation", and a margin of .10 to reflect the difference in regulatory regimes between that facing the US firms and that facing these New Zealand firms. However, the regulatory situation underlying Transpower's Formal Settlement Proposal is quite different to that of the New Zealand lines businesses that are subject to five-year price and quality thresholds, and therefore an asset beta other than .40 may be appropriate.

The features of Transpower's proposal that are relevant to its asset beta are as follows (Transpower, 2006a). Firstly, some proposed capital expenditures would be subject to approval by the Electricity Commission. Secondly, assets would be valued in

accordance with depreciated historic cost. Thirdly, the possibility of asset stranding would be pre-empted through accelerated depreciation. Fourthly, prices would be reset annually to reflect the prevailing WACC and forecast output level, subject to the Commission's approval. Fifthly, in respect of WACC, Transpower's shareholders would bear the consequences of any shocks arising within this period. Sixthly, in respect of actual revenues diverging from forecast revenues (due to demand shocks), Transpower's customers rather than shareholders would bear the consequences of this, i.e., revenues larger than forecast would induce rebates to customers and revenues less than forecast would induce higher future revenues. Seventhly, in respect of operating costs, prices would be set at the commencement of the five year term of the administrative settlement to reflect forecast operating costs over that period, subject to an exception for CPI inflation (for which actual rather than forecast values are invoked)[5]. Finally, Transpower's shareholders would bear the consequences of any variations between actual and forecast operating costs over the period until the cost forecast was revised; this would include variations due to demand differing from the forecast level.

The regulatory regime implied by these features has strong similarities to that facing US electric and gas utilities. However, there are four potentially significant points of distinction. Firstly, in respect of the US firms subject to "rate-of-return regulation", prices are reset if the actual rate of return deviates materially from the prescribed rate, with the resetting initiated by either the firm or its customers (Brennan and Schwartz, 1982; Beesley and Littlechild, 1989). Liston (1993) reports an average interval of 18-24 months between price resets, and the evidence presented in Parmesano and Makholm (2004, Figure 1) suggests that it has increased since then. By contrast, under Transpower's proposal, prices would be reset annually in respect of all factors other than operating costs and up to five yearly in respect of operating costs. It is not clear whether Transpower or the US firms would experience the more rapid response to cost and demand shocks, and therefore the lower asset beta. Even if Transpower were subject to annual price resetting in respect of *all* of its costs, it still might not

[5] Forecast CPI would be used in setting prices, but any forecast errors would be borne by customers rather than shareholders, through rebates or clawbacks. Transpower (2006a, page 10) has proposed a second exception, relating to material increases in operating costs that are beyond Transpower's reasonable control. However, the Commerce Commission (2006b, page 7) has rejected this proposal.

experience a more rapid response to cost and demand shocks than the US firms because the interval characterising the US firms reflects both the frequency of large shocks as well as the delays in responding to them.[6] Accordingly, and in respect of this point, we cannot draw conclusions about the relative asset betas under the two regimes. However, any difference is likely to be small.

Secondly, some of the US firms are subject to "incentive regulation" rather than "rate-of-return regulation", most particularly rate freezes and price caps (Sappington et al, 2001). The anticipated effect of this is to raise systematic risk for those firms, and therefore raise the average asset beta for the US firms above that of Transpower. Accordingly, the average estimated asset beta for the US firms (.30) would be an upward biased estimate of Transpower's asset beta. However, in respect of the 28 firms identified by Sappington et al (2001, Table 2) as being subject to incentive regulation, removal of them from the data sets in Lally (2006, Table 3) does not exert a material effect upon the estimated asset beta of .30. For example, in respect of the S&P data sets referred to in Lally (2006, Table 3), only 6 of the 28 firms appear in the S&P data sets[7]. Removal of these firms from the data sets that are associated with the period of incentive regulation leads to all six being removed from the 1999-2003 data set and three of them (the first three firms in footnote 3) from the 1994-1998 data set. The average asset betas are then recalculated, thereby reducing the 1994-1998 average by .01 and raising the 1999-2003 average by .02. These effects are trivial, and suggest that the data in Lally (2006, Table 3) are satisfactory for estimating the asset beta of firms subject to rate-of-return regulation.

Thirdly, Transpower is involved only in transmission whereas the US firms are engaged in a range of activities including generation, distribution, retail and various unregulated activities. Potentially, the most serious concern here is in respect of unregulated activities, and the anticipated effect is to raise the average asset beta of

[6] To illustrate this, suppose that a cost or demand shock is equally likely to arise 1, 2 or 3 years after the last such shock. In this case, the US firms will experience an average interval of two years between price resets. However, this does not imply any delay in reaction to the shock. By contrast, firms subject to annual price resetting will experience a delay of up to one year in having their output prices reset in response to a shock.

[7] These firms are AmerenUE, Black Hills Power and Light, EntergyLA, NSTAR, Otter Tail Power, and Southern California Edison Co.

the US firms[8]. However, the extent of these unregulated activities does not appear to be substantial. In respect of US electric utilities over the period 1980-1997, Jandik and Makhija (2005, Table 1) report the proportion of assets associated with non-core activities ("diversified assets") at 10-20%, and some of this involves other rate-of-return regulated areas, most particularly gas distribution. So, whilst the effect of this point is likely to be to raise the average asset beta of the US firms above that of Transpower, the effect is likely to be small.

Fourthly, the shareholders of the US firms are exposed to demand shocks to their revenues over the period between price resets whereas Transpower's shareholders would not be (because its customers bear such shocks). This implies that the US firms would face higher systematic risk than Transpower. Although it is not possible to quantify this difference, it might represent a significant fraction of the systematic risk faced by the US firms.

In summary, the regulatory regime implied by Transpower's proposal resembles that for US electric and gas utilities. Four differences are identified. The effect of the first is unclear, but it is likely to be small. The remaining three are expected to yield a higher average asset beta for the US firms; empirical evidence on one of these points reveals no material effect, empirical evidence on another suggests that the effect would be modest, and empirical evidence on the remaining point is lacking but the effect might be significant. Taking account of all this, the estimated asset beta for the US firms (.30) represents an upper bound on the estimate for Transpower.

3.5 Contrary Arguments

Transpower (2006b, pp. 6-8) contests the analysis in the preceding section. In respect of the first point of difference with the US firms (the interval before output prices are reset), Transpower argues that the US firms pass through operating costs to their customers whereas Transpower will face operating cost shocks for up to five years (arising from demand shocks and from input price inflation deviating from CPI inflation). Accordingly, it argues that Transpower will face higher systematic risk

[8] Rosenberg and Guy (1976, Table 2) show that energy suppliers and utilities have the lowest betas after correction for various firm specific effects. Thus, diversification into unregulated activities is likely to raise the asset betas of electric and gas utilities.

than the US firms. However, the US firms do not pass through all of their operating costs. Furthermore, the effect of demand shocks upon Transpower's operating costs will be to *lower* rather than to raise its systematic risk. For example, higher demand (which will be associated with higher GDP and therefore higher returns on the market portfolio) will raise Transpower's operating costs and therefore lower its returns; this lowers systematic risk. Consequently, Transpower's arguments do not support the conclusion that Transpower will face higher systematic risk than the US firms.

In respect of the second point of difference with the US firms (incentive regulation for some of them), Transpower argues that it will face incentive regulation in relation to its operating costs, and this implies that its systematic risk will be no lower than that of the US firms. However, even if Transpower's situation in respect of operating costs matched that of US firms subject to incentive regulation, the situation in respect of its revenues will imply less risk to Transpower than for the US firms subject to incentive regulation; thus, across its cash flows in aggregate, Transpower will face less systematic risk than the US firms subject to incentive regulation.

In respect of the fourth point of difference with the US firms (exposure to demand shocks to revenues over the interval between price resets), Transpower argues that its operating costs are fixed for a longer period than for the US firms, and the effect of demand shocks on its operating costs will be to raise its systematic risk above that of the US firms. However, as noted earlier, the effect of demand shocks upon Transpower's operating costs will be to *lower* rather than raise it systematic risk. For example, higher demand (which will be associated with higher GDP and therefore higher returns on the market portfolio) will raise Transpower's operating costs and therefore lower its returns; this lowers systematic risk.

Transpower (2006b, page 6) also argues that newly constructed assets will enter the asset base at the lower of approved and actual cost (under the administrative settlement proposal), and this will induce higher systematic risk for Transpower than for the US firms. However, this argument is subject to a number of difficulties. Firstly, as noted by the Commerce Commission (2006b, page 3), approval for construction cost overruns *may* be retrospectively granted. Secondly, the US firms are also subject to the possibility of construction cost overruns not being allowed by

their regulators. Thirdly, even if construction cost overruns by Transpower were not retrospectively approved and the actual costs of the US firms were always accepted by their regulators, the effect would be to induce *lower* rather than higher systematic risk for Transpower. To illustrate this, suppose that construction costs of $100m are approved. Also, if GDP is less than expected (in which case returns on the market portfolio will tend to be low), construction costs will tend to be less than $100m (say $90m) and Transpower's output prices will be set to recover this figure of $90m; Transpower will therefore earn its cost of capital on its investment of $90m. By contrast, if GDP is greater than expected (in which case returns on the market portfolio will tend to be high), construction costs will tend to be more than $100m (say $110m) but only $100m will be allowed and Transpower's output prices will be set to recover this figure of $100m; Transpower will then earn subnormal returns on its investment of $110m. So, Transpower will tend to earn subnormal returns when market returns are high. If the US firms are not subject to the same effect, then Transpower's systematic risk will tend to be *less* than for the US firms. Fourthly, and finally, given that the revenue implications of assets constructed over the five year term of the administrative settlement would be small relative to the revenue implications of the initial asset base, any effect upon Transpower's systematic risk (relative to that for the US firms) from its revenues being based upon the lower of actual and approved construction costs is likely to be small.

Transpower (2006b, page 7) goes on to argue that its systematic risk under the administrative settlement proposal along with annual price resetting (except for operating costs) will lie between that of rate of return regulation and UK style price cap regulation with annual price resetting. Furthermore, it argues that the appropriate asset betas for US rate-of-return regulation and for UK price-cap regulation under annual price resetting would be .30 and .50 respectively. Accordingly, it favours an asset beta of .40 for Transpower when prices are reset annually. In support of the asset betas of .30 and .50, it cites Lally (2006) for the first figure and Lally (2006) in support of a margin of .20 for the UK firms over the US firms. The claim that the systematic risk faced by Transpower under the administrative settlement proposal will exceed that of the US firms has been addressed above and rejected. Furthermore, the claim that Lally (2006) supports of a margin of .20 for the UK firms under annual price resetting over the US firms is also incorrect. Lally (2006, page 122) favours the

same asset beta of .30 for the US firms and price-cap regulation with a regulatory cycle of one year[9].

Transpower (2006b, pp. 1-6) also argues that the systematic risk that it will face (under the administrative settlement proposal) is at least as great as that currently faced by the distribution businesses under the price threshold. Since the Commission favours an asset beta of .40 for the latter firms, this comparison supports an asset beta for Transpower of at least .40. In support of their assertion that the systematic risk faced by Transpower under the administrative settlement proposal will be at least as great as that currently faced by the distribution businesses under the price threshold, Transpower's principal arguments are as follows. Firstly, Transpower argues that newly constructed assets will enter the asset base at the lower of approved and actual cost, and this will induce higher systematic risk for Transpower than for the distribution businesses. However, since the distribution businesses are not subject to the same process, the effect would be to induce *lower* rather than higher systematic risk for Transpower (as discussed above in the comparison of Transpower with the US firms). Secondly, Transpower argues that the fact that it will not bear the risk of demand shocks upon revenues whilst the distribution businesses do bear such risks is not important because demand shocks are not significant in this industry. However, even if these shocks are not significant in an absolute sense, they may explain a significant portion of the (low) asset betas of these firms. Thirdly, Transpower argues that it will face cost shocks for up to five years before output prices are reset whereas the distribution businesses are not subject to such a long delay. However, at least in respect of demand shocks to operating costs, these have the effect of reducing Transpower's systematic risk (as discussed above in the comparison of Transpower with the US firms). All of these points suggest that Transpower's systematic risk will be *less* rather than at least as great as that of the distribution businesses.

In addition to these points, an indirect comparison of the systematic risk that will be faced by Transpower (under the administrative settlement proposal) with that faced by the distribution businesses rebuts Transpower's conclusion. As argued in the previous section, Transpower will face less systematic risk than the US firms principally

[9] Transpower (2006b, page 7) attributes eight numbers in the table on this page to Lally. Only four of these numbers are correctly reported.

because it will be protected from demand shocks to its revenues over the interval between price resets. By contrast, the New Zealand distribution businesses face only price and quality thresholds (set for five years), with no direct linkage of the price thresholds to costs, whereas the US firms are close to cost-plus operations. Consequently, the output prices of the New Zealand distribution businesses are likely to conform less closely to their costs than for the US firms, and therefore higher systematic risk is present. So, Transpower will face less systematic risk under the administrative settlement proposal than the US firms whilst the New Zealand distribution businesses face more systematic risk than the US firms. This implies that Transpower will face less systematic risk under the administrative settlement proposal that that currently faced by the distribution businesses under the price threshold.

3.6 Point Estimate for WACC

Taking account of equations (1)…(4) and the parameter values favoured above, the point estimate for WACC is then as follows.

$$\beta_e = .30\left[1 + \frac{.40}{.60}\right] = .50$$

$$k_e = .0713(1 - .33) + .07(.50) = .0828$$

$$k_d = .0713 + .01 = .0813$$

$$WACC = .0828(.60) + .0813(1 - .33)(.40) = .071$$

This point estimate for WACC invokes an upper bound on the estimated asset beta, and therefore gives rise to an upper bound on the WACC. Furthermore, this upper bound on WACC is remarkably close to Transpower's (2006a) estimate of .072 despite variations in a number of individual parameter values. In particular, Transpower's use of the ten-year rather than the one-year risk free rate induces a reduction in the risk free rate of .014, and this is almost entirely offset by use of a higher market risk premium (.075 versus .07), a higher asset beta (.35 versus .30), a higher leverage (.45 versus .40), and a lower value for the tax parameter T (.198 versus .33).

3.7 The Standard Deviation of the Estimate

Equations (1)…(4) along with $T = T_c = .33$ imply that the WACC is as follows.

$$WACC = R_f(1-.33) + \phi\beta_a + \rho L(1-.33)$$

Uncertainty exists in respect of the last four parameters in this equation. Under the plausible assumption that the estimation errors in respect of these parameters are independent, the standard deviation of the estimated WACC is as follows.

$$\sigma(\hat{WACC}) = \sqrt{\begin{array}{l}\sigma^2(\hat{\phi})\sigma^2(\hat{\beta}_a) + E^2(\hat{\phi})\sigma^2(\hat{\beta}_a) + E^2(\hat{\beta}_a)\sigma^2(\hat{\phi}) \\ +(1-0.33)^2\left[\sigma^2(\hat{\rho})\sigma^2(\hat{L}) + E^2(\hat{\rho})\sigma^2(\hat{L}) + E^2(\hat{L})\sigma^2(\hat{\rho})\right]\end{array}} \qquad (6)$$

Lally (2007, section 9.1) estimates the standard deviations associated with ϕ, β_a, ρ and L at .015, .136, .002 and .15 respectively. Invoking these standard deviations along with the parameter point estimates in the previous section, it follows from equation (6) that $\sigma(\hat{WACC}) = .011$.

4. Implications of revising the WACC Less Frequently

The analysis in the preceding sections presumes that the WACC is revised annually. However, the WACC may be fixed for the term of the settlement, and this term would be either four or five years. This has implications for the term of the risk free rate that is used in estimating WACC and also for the estimate of the asset beta.

In respect of the term of the risk free rate, previous analysis (Lally, 2006) argues for a term that matches the frequency with which changes in the rate are recognised, and for estimating the rate using the average over the preceding month (Lally, 2006, section 4). So, if the WACC was fixed for a term of four years, the appropriate risk free rate to use would be the four year rate. Similarly, if the WACC was fixed for a term of five years, then the appropriate risk free rate to use would be the five year rate. Averaged over August 2006, these rates are 6.44% and 6.29% respectively.[10]

[10] The Reserve Bank of New Zealand reports the two and five year rates averaged over August 2006 as 6.65% and 6.19% respectively. Following the compounding correction described in footnote 2, these

In respect of the asset beta appropriate to circumstances in which the WACC is fixed for either four or five years, the following regulatory regimes should be considered.

(a) Regime 1: Transpower's Formal Settlement Proposal.

(b) Regime 2: As per regime 1 except that the WACC is set for four years.

(c) Regime 3: As per regime 1 except that the WACC is set for five years.

(d) Regime 4: Price control for five years.

As previously discussed, the appropriate asset beta for regime 1 is less than .30. Also, as discussed in Lally (2006, section 5), the appropriate asset beta for regime 4 would be .50. Also, regime 3 differs from regime 4 in that the former involves prices being reset annually to reflect the demand forecast, and the revenue effects of errors in forecasting demand being borne by Transpower's customers rather than its shareholders, i.e., there is no revenue risk under regime 3. The following table summarises the shocks that Transpower's shareholders would be exposed to under the four possible regimes, and the maximum terms of the exposures.

Table 1: Term of Exposure to Shocks Faced by Transpower under Various Regimes

	Regime 1	Regime 2	Regime 3	Regime 4
WACC shocks	1 yr	4 yrs	5 yrs	5 yrs
Real Opex shocks	5 yrs	5 yrs	5 yrs	5 yrs
Revenue shocks	No	No	No	5 yrs
Inflation shocks	No	No	No	No
Asset Base shocks	Minimal	Minimal	Minimal	Minimal

We now consider the asset beta for regime 3. As indicated in Table 1, this regime involves risks that are less than for regime 4 but greater than for regime 1. Regime 4 warrants an asset beta of .50 and regime 1 warrants an asset beta of no more than .30. Accordingly, regime 3 warrants an asset beta whose upper bound must lie between .30 and .50. Regime 3 has higher risk than regime 1 in that the WACC is set for five

rates become 6.76% and 6.29% respectively. The four year rate is then generated by linear interpolation from these two and five year rates, to yield 6.44%.

years rather than one. By contrast, regime 3 has lower risk than regime 4 in that there is no revenue risk. It is not possible to ascertain whether the risk differential between regimes 1 and 3 is more or less than that between 3 and 4. Accordingly, one is bound to presume that they are similar and therefore to estimate the upper bound on the asset beta for regime 3 at the midpoint of .40.

Finally, the asset beta for regime 2 is considered. Since the upper bound on the asset beta for regime 1 is .30, and the upper bound for regime 3 is .40, and the regimes differ only in the term for which the WACC is set, and these terms are 1, 4 and 5 years respectively, this suggests that the upper bound on the asset beta for regime 2 should be .375.

In summary, if the WACC is fixed for four years rather than one year, and the regime is otherwise identical to that in Transpower's Formal Settlement Proposal, then the appropriate risk free rate to use is that for four years (6.44%) rather than one year and the upper bound on the asset beta rises from .30 to .375. Taking account of these parameter values, equations (1)…(4) and other parameter values favoured above, the point estimate for WACC is then as follows.

$$\beta_e = .375\left[1 + \frac{.40}{.60}\right] = .625$$

$$k_e = .0644(1 - .33) + .07(.625) = .0869$$

$$k_d = .0644 + .01 = .0744$$

$$WACC = .0869(.60) + .0744(1 - .33)(.40) = .072$$

Also, if the WACC is fixed for five years rather than one year, and the regime is otherwise identical to that in Transpower's (2006a) first Formal Settlement Proposal, then the appropriate risk free rate to use is that for five years (6.29%) rather than one year and the upper bound on the asset beta rises from .30 to .40. Taking account of these parameter values, equations (1)…(4) and other parameter values favoured above, the point estimate for WACC is then as follows.

$$\beta_e = .40\left[1 + \frac{.40}{.60}\right] = .667$$

$$k_e = .0629(1 - .33) + .07(.667) = .0888$$

$$k_d = .0629 + .01 = .0729$$

$$WACC = .0888(.60) + .0729(1 - .33)(.40) = .073$$

So, if the WACC is fixed for four years rather than one year, and the regime is otherwise identical to that in Transpower's first Formal Settlement Proposal, the WACC rises from .071 to .072. If the WACC is instead fixed for five years, then the WACC rises further from .072 to .073.

5. Transpower's Third Proposal

5.1 Introduction

Transpower's third Formal Settlement Proposal involved a WACC estimate of .074 (Transpower, 2007a, Appendix). This proposal differs from Transpower's initial proposal in five respects. Firstly, the asset beta is raised from .35 to .40, apparently on the grounds that such a figure is suggested in section 3.8 above. Secondly, Transpower's estimates for leverage, the market risk premium and the tax parameter *T* are now .40, .07 and .33 respectively. These figures now match those proposed in section 3 above. Thirdly, Transpower adds a margin of .001 to their point estimate of .073, to yield their proposed figure of .074. Fourthly, Transpower argues that the forthcoming reduction in the company tax rate to 30% (from 1.4.2008) should induce an increase in the WACC, due to the reduction in the tax deduction on debt. Fifthly, Transpower suggests that the interest tax parameter *T* in the simplified Brennan-Lally version of the CAPM should be reduced, although no rationale is offered for this.

In respect of the increase in the asset beta to .40, and as indicated in section 3.8, this would be appropriate if the WACC was fixed for five years. However, Transpower's third proposal still seems to envisage annual resetting of WACC (ibid, p 12, paragraph P) and this is inconsistent. In respect of Transpower's addition of a margin of .10%, no explanation is given for this. However, as discussed in Lally (2006, section 9), I favour addition of a margin to deal with uncertainty in the WACC estimate. Furthermore, the estimation of the standard deviation of the WACC distribution in

section 3.7 above is intended to facilitate addition of such a margin. In respect of the proposed reduction in the tax parameter *T*, this tax parameter reflects personal tax rates on interest and capital gains, and these tax rates are unrelated to a reduction in the corporate tax rate; so, their suggestion here is incorrect. Finally, in respect of their proposed reduction in the company tax rate, their proposal is correct. However, it is incomplete in that it fails to consider the impact of the company tax reduction on the cost of equity.[11] We therefore consider this issue in the next section, and then go on in the following section to suggest some modification to the assumptions underlying the simplified Brennan-Lally model. The analysis in these two sections extends to electricity lines businesses in general.

5.2 The Impact of a Reduction in the Company Tax Rate on the Cost of Equity

Having adopted the estimate of .33 for the tax parameter *T*, Transpower's proposed methodology for determining the cost of equity now corresponds to the simplified Brennan-Lally version of the CAPM. This specifies a firm's cost of equity as

$$k_e = R_f(1-T_I) + \phi\beta_e \tag{7}$$

where

$$\phi = k_m - R_f(1-T_I) \tag{8}$$

and T_I is the average (across equity investors) of their marginal tax rates on ordinary income, and k_m is the expected rate of return on the market portfolio. Transpower uses this model both before and after the change in the corporate tax rate. The general form of the model is as follows (Lally, 1992; Cliffe and Marsden, 1992)

$$k_e = R_f(1-T) + DT_d + \phi\beta_e \tag{9}$$

where

$$\phi = k_m - D_m T_{dm} - R_f(1-T) \tag{10}$$

[11] There are also effects upon the tax expense within the cash flows. However, this is not a WACC issue. It is unclear whether Transpower has taken account of this issue in their third Formal Settlement Proposal.

and D is the firm's cash dividend yield, T is a tax parameter that reflects differential tax treatment of interest and capital gains, T_d is a tax parameter that reflects differential tax treatment of capital gains and the firm's cash dividends, D_m is the dividend yield on the cash market portfolio, and T_{dm} is a tax parameter that reflects differential tax treatment of capital gains and the market portfolio's cash dividends. Lally (2000) shows that the tax parameters T_d and T_{dm} can be expressed as follows

$$T_d = T - (1-T)U\frac{IC}{DIV} \tag{11}$$

$$T_{dm} = T - (1-T)U\frac{IC_m}{DIV_m} \tag{12}$$

where U is the weighted average utilisation rate on imputation credits, DIV is the cash dividend paid by the firm, IC is the imputation credits attached to the firm's cash dividend, DIV_m is the cash dividends on the market portfolio, and IC_m is the imputation credits attached to the cash dividends on the market portfolio. The simplified Brennan-Lally version of the CAPM arises from this general form by assuming that

(a) capital gains taxes are zero (implying that $T = T_I$).
(b) all firms attached maximum imputation credits to dividends (at the rate .4925).
(c) shareholders can fully utilise the imputation credits (implying that $U = 1$).

In addition, following Lally and Marsden (2004), the most recent estimate for T_I is .33. With these assumptions and estimates, the tax parameters T_d and T_{dm} are zero and the tax parameter T reduces to T_I, yielding the simplified Brennan-Lally version of the CAPM shown in equations (7) and (8).

The company tax rate is relevant to this model through the maximum attachment rate for imputation credits. At the current tax rate of .33, this maximum attachment rate is .4925 as noted above, i.e.,

$$\frac{T_c}{1-T_c} = \frac{.33}{1-.33} = .4925$$

Consequently, a reduction in the company tax rate to .30 will reduce this maximum attachment rate for imputation credits to .4286. Substitution of this into equations

(11) and (12), whilst retaining the other assumptions of the simplified Brennan-Lally model, yields

$$T_d = T_{dm} = .33 - (1 - .33)(1)(.4286) = .043$$

Consequently, so long as a firm is paying dividends, the dividend term no longer disappears from equations (9) and (10), and the simplification manifest in equations (7) and (8) is lost. Thus, equations (7) and (8) would have to be replaced by the following equations.

$$k_e = R_f(1 - T_I) + .043D + \phi\beta_e \quad (13)$$

$$\phi = k_m - .043D_m - R_f(1 - T) \quad (14)$$

In respect of estimating the market risk premium shown in equation (10), the increase in the parameter T_{dm} should induce a countervailing increase in k_m. Consequently, the prevailing estimate of .07 for the market risk premium should not be affected, and therefore the cost of equity would rise due to the increase in the tax parameter T_d in equation (9). Intuitively, the reason is as follows. Dividend imputation reduces the tax rate on cash dividends, by reclassifying corporate tax as personal tax, and therefore lowers the cost of equity. Consequently, a reduction in the corporate tax rate constitutes a reduction in the benefits flowing from imputation, and therefore raises the cost of equity.

Consistent with the approach to assessing a firm's leverage in Lally (2006, section 6), this cash dividend yield D should be the firm's actual dividend yield if actual costs are generally employed in setting the price cap, the firm's optimal dividend yield if efficient costs are generally employed in setting the price cap, and the optimal yield should be determined from averaging over firms in the relevant industry.[12] If firms used in the latter exercise are restricted to currently listed firms, then the relevant set matches that discussed in Lally (2006, section 6), i.e., Auckland International Airport,

[12] Since D is defined within equation (13) in market value terms (i.e., annualised cash dividend as a proportion of equity value) then such firms must be either listed or subject to a regulatory process that has the effect of driving the market value of equity close to its book value.

Horizon Energy and Vector. The current dividend yields of these firms are .031, .051 and .045, with an average of .042.[13]

To illustrate the effect upon the WACC estimate of this tax change, we start with equation (7), the WACC formula and the parameter values used in Transpower (2007a, Appendix, page 16). The result is as follows.

$$\hat{k}_e = .063(1-.33) + .40\left[1 + \frac{.40}{.60}\right].07 = .0889$$

$$\hat{WACC} = .60(.0889) + .40(.063 + .01)(1-.33) = .0729$$

We now invoke equation (13), the WACC formula, a cash dividend yield of .042, a company tax rate of .30, and the other parameter values used above. The result is as follows.

$$\hat{k}_e = .063(1-.33) + .042(.043) + .40\left[1 + \frac{.40}{.60}\right].07 = .0907$$

$$\hat{WACC} = .60(.0907) + .40(.063 + .01)(1-.30) = .0749$$

So, the WACC estimate has risen from .0729 to .0749. Half of this increase (.10%) is due to the rise in the cost of equity and the other half (.10%) to the increase in the post-tax cost of debt.[14]

5.3 Alternative Simplifying Assumptions

The analysis shown in the previous section leads to the incorporation of dividend terms into the CAPM, and therefore loss of the simple structure shown in equations (7) and (8). Since the latter model rests upon a number of simplifying assumptions, listed on page 24, we now consider whether there is an alternative set of simplifying assumptions consistent with the absence of the dividend terms from the CAPM. As noted in the previous section, retention of assumption (b) implies that the maximum attachment rate for imputation credits is now .4286. Assumption (a) asserts that

[13] Data from the National Business Review, June 8 2006.

[14] The latter figure matches the increase from .073 to .074 shown in Transpower (2007a, Appendix, page 16).

capital gains taxes are zero, and leads to the tax parameter T being equal to T_I, with the latter empirically estimated at .33. However, the most recent empirical estimate for T is .275, due to some investors being subject to capital gains tax (Lally and Marsden, 2004, Table 1). So, replacing this assumption by the assumption that T is .30 would be more accurate, and the resulting set of assumptions would be as follows.

(d) T is estimated at .30, implying capital gains taxes for some investors.

(e) all firms attach maximum imputation credits to dividends (at the rate .4286).

(f) shareholders can fully utilise the imputation credits (implying that $U = 1$).

Substitution of these assumptions into equations (11) and (12) yields $T_d = T_{dm} = 0$. Substitution of this into the general form of the CAPM shown in equations (9) and (10) yields the following model.

$$k_e = R_f(1-.30) + \phi\beta_e \tag{15}$$

$$\phi = k_m - R_f(1-.30) \tag{16}$$

In respect of estimating the market risk premium shown in equation (16), the reduction in the estimate for T from .33 to .30 should induce a countervailing reduction in k_m. Consequently, the prevailing estimate of .07 for the market risk premium should not be affected. Thus, in the face of a reduction in the corporate tax rate to 30%, replacing the simplifying assumptions (a), (b), (c) by (d), (e), (f) is both more realistic and continues to be consistent with the absence of the dividend terms from the CAPM.

We now consider the result of using equation (15). As shown in the previous section, the use of equation (7), the WACC formula and the parameter values used in Transpower (2007a, Appendix, page 16) leads to a WACC estimate of .0729. By contrast, adoption of equation (15), the WACC formula, a company tax rate of .30, and the other parameter values used above leads to the following result.

$$\hat{k}_e = .063(1-.30) + .40\left[1 + \frac{.40}{.60}\right].07 = .0908$$

$$\hat{WACC} = .60(.0908) + .40(.063 + .01)(1-.30) = .0749$$

So, the WACC estimate has risen from .0729 to .0749. Half of this increase (.10%) is due to the rise in the cost of equity and the other half (.10%) to the increase in the post-tax cost of debt. These results are almost identical to those in the previous section, although a different model has been used.

5.4 Summary

In summary, Transpower's third Formal Settlement Proposal (2007a, Appendix) differs from the initial proposal in five respects. Firstly, the asset beta is raised from .35 to .40. However, this proposed change is not consistent with annual resetting of WACC. Secondly, Transpower estimates for leverage, the market risk premium and the tax parameter *T* are now .40, .07 and .33 respectively. I agree with these proposed changes. Thirdly, Transpower adds a margin of .001 to their point estimate of .073, to yield their proposed figure of .074. I agree with the general principle of a margin to deal with uncertainty over the WACC estimate. Fourthly, Transpower's proposal to reduce the company tax rate used in determining the tax deduction on interest within WACC to .30 (from 1.4.2008) is correct. However, there are further implications of this tax change for the cost of equity, and consideration of these wider effects suggests that the tax parameter *T* within the cost of equity should also be reduced to .30 from 1.4.2008. Fifthly, Transpower's suggestion that this tax parameter *T* be reduced accords with the conclusion just stated.

6. Transpower's Final Proposal

6.1 Introduction

Transpower's final Formal Settlement Proposal (Transpower, 2007c) differs from its third proposal in three respects. Firstly, the proposal would apply to a four rather than to a five year term (from 1.7.2007). Secondly, the WACC would be set for the entire four years rather than be subject to annual revisions. Thirdly, a separate WACC would apply to the one year term preceding 1.7.2007. Taking account of the relevant risk free rates (as noted in Transpower, 2007b), and the upward adjustment arising from the announced decrease in the corporate tax rate, Transpower (2007c) has proposed figures of .072 for the one year period, .077 for the first year of the four year term, and .078 for the remaining years in the four year term. The following two sections review these proposals.

6.2 Analysis for the One Year Period

In respect of the period 1.7.2006 to 30.6.2007, the issue of an appropriate WACC for a one year period has been examined in section 3, and concludes with a point estimate of .071 (section 3.6) and a standard deviation of .011 (section 3.7). In respect of the point estimate, this reflected the average one-year government stock rate over August 2006. However, since the period in question commences on 1.7.2006, the relevant period for averaging the one-year government stock rate is June 2006, and this leads to a figure of .0701.[15] All other parameter estimates are unchanged. So, with this change to the risk free rate, and invoking equations (1)….(4), the WACC point estimate is now as follows.

$$\beta_e = .30\left[1 + \frac{.40}{.60}\right] = .50$$

$$k_e = .0701(1 - .33) + .07(.50) = .0820$$

$$k_d = .0701 + .01 = .0801$$

$$WACC = .0820(.60) + .0801(1 - .33)(.40) = .0707$$

With rounding to the third decimal point, the result is still .071. In respect of the standard deviation, the relevant parameter values are unchanged and the estimate is therefore still .011.

6.3 Analysis for the Four Year Period

In respect of the four year period from 1.7.2007, the issue of an appropriate WACC for a four year period has been examined in section 4 and concludes with a point estimate of .072. This point estimate reflected the average four-year government stock rate over August 2006. However, since the period in question commences on 1.7.2007, the relevant period for averaging the four-year government stock rate is June 2007, and this leads to a figure of 7.33%.[16] All other parameter estimates are as

[15] The Reserve Bank of New Zealand reports a figure of 6.89% (www.rbnz.govt.nz), which arises from a semi-annual rate of .03445 along with annualisation using simple-interest. However, the appropriate annualisation process involves compounding, and this gives rise to an annualised figure of 7.01%.

[16] The Reserve Bank of New Zealand reports the two and five year rates averaged over June 2007 as 7.33% and 7.13% respectively. Following the compounding correction described in footnote 15, these rates become 7.46% and 7.26% respectively. The four year rate is then generated by linear interpolation from these two and five year rates, to yield 7.33%.

detailed in section 4. So, with this change to the risk free rate, and following equations (1)…(4), the WACC point estimate is now as follows.

$$\beta_e = .375\left[1 + \frac{.40}{.60}\right] = .625$$

$$k_e = .0733(1 - .33) + .07(.625) = .0929$$

$$k_d = .0733 + .01 = .0833$$

$$WACC = .0929(.60) + .0833(1 - .33)(.40) = .0781 \qquad (17)$$

This rate will be appropriate until the corporate tax rate changes to 30%, on 1.4.2008. Section 5 notes that this event reduces the tax term in the last equation to .30, and further argues that the tax term in the equation for k_e above should also be reduced to .30. With these changes, the WACC estimate is now as follows.

$$\beta_e = .375\left[1 + \frac{.40}{.60}\right] = .625$$

$$k_e = .0733(1 - .30) + .07(.625) = .0951$$

$$k_d = .0733 + .01 = .0833$$

$$WACC = .0951(.60) + .0833(1 - .30)(.40) = .0804 \qquad (18)$$

In respect of the standard deviation for the WACC estimate in equation (17), equation (6) is still valid but the mean and standard deviation for the asset beta are no longer .30 and .136 respectively. Following Lally (2006, section 5.3), the point estimate for the asset beta is as follows

$$\hat{\beta}_a = \hat{\beta}_{Ea} + \hat{\Delta}\hat{U}\hat{W} = .30 + .20(.50)(.75) = .375 \qquad (19)$$

where β_{Ea} is the asset beta for electricity lines businesses under US style rate-of return regulation, Δ is the margin for five year price-cap regulation relative to rate-of-return regulation, U is a parameter that reflects the systematic risk for Transpower under a five year settlement term in relation to rate of return regulation and five year price capping (the point estimate of .50 reflecting a belief that Transpower would lie

midway between these two bounds) and W is a parameter that reflects the systematic risk for Transpower under a four year settlement term in relation to rate of return regulation and a five year settlement term (the point estimate of .75 reflecting a belief that a four year term would lie three quarters of the way between these two bounds). Following the analysis in Lally (2006, Appendix 7), it follows that

$$\sigma^2(\hat{\beta}_a) = \sigma^2(\hat{\beta}_{Ea}) + \sigma^2(\hat{\Delta}\hat{U}\hat{W})$$
$$= \sigma^2(\hat{\beta}_{Ea}) + \sigma^2(\hat{\Delta}\hat{U})\sigma^2(\hat{W}) + E^2(\hat{\Delta}\hat{U})\sigma^2(\hat{W}) + E^2(\hat{W})\sigma^2(\hat{\Delta}\hat{U}) \quad (20)$$

and

$$\sigma^2(\hat{\Delta}\hat{U}) = \sigma^2(\hat{\Delta})\sigma^2(\hat{U}) + E^2(\hat{\Delta})\sigma^2(\hat{U}) + E^2(\hat{U})\sigma^2(\hat{\Delta}) \quad (21)$$

In respect of the uncertainty surrounding the true but unknown value for U, a plausible probability distribution for U is that it is uniformly distributed on the range from zero to 1, i.e., the systematic risk for Transpower under a five year term may be as low as that for rate of return regulation and as high as that for a five year price cap. Invoking the formula for the standard deviation of a uniform distribution (see Mood et al, 1974, page 106), the result is as follows.

$$\sigma(U) = \sqrt{\frac{1-0)^2}{12}} = .29$$

In respect of the uncertainty surrounding the true but unknown value for W, a plausible probability distribution for W is that it is uniformly distributed on the range from .50 to 1, i.e., the systematic risk for Transpower under a four year settlement term may be as high as that for a five year term and with matching uncertainty below the point estimate of .75. Invoking the formula for the standard deviation of a uniform distribution (see Mood et al, 1974, page 106), the result is as follows.

$$\sigma(W) = \sqrt{\frac{(1-0.50)^2}{12}} = .14$$

Substitution of these parameter values into equation (21) and then (20) yields an estimate for the standard deviation on the asset beta of .154. Substitution of this into

equation (6) along with the point estimate for the asset beta of .375 and other parameter values used in section 3.7 yields $\sigma(\hat{WACC})$ = .012.

Finally, in respect of the standard deviation for the WACC estimate in equation (18), equation (6) is still valid subject to the tax rate .33 being replaced by .30. In addition, as above, the mean and standard deviation for the asset beta are now .375 and .154 respectively rather than .30 and .136. Substitution of these values into equation (6) along with the other parameter values used in section 3.7 yields $\sigma(\hat{WACC})$ = .012.

In summary, in respect of the four year period commencing on 1.7.2007, the point estimate for WACC should be .078 (with a standard deviation on the estimate of .012) until the corporate tax rate falls to 30% on 1.4.2008. From that point, the point estimate rises to .080 (with a standard deviation on the point estimate of .012). These figures are larger than Transpower's proposals of .077 and .078 respectively.

7. Conclusions

Transpower's first Formal Settlement Proposal covered a five year term with annual resetting of the WACC value. The WACC model proposed matched that favoured by the Commission along with use of the ten-year risk free rate, a corporate tax rate of .33, an asset beta of .35, leverage of .45, a market risk premium of .075, a estimate for the tax parameter *T* of .198, and a debt margin of .01. In conjunction with the risk free rate prevailing at the time of the proposal, these parameter values implied a WACC estimate of .072.

Of these parameter values, the corporate tax rate is uncontroversial, and consistency with previous analysis requires a market risk premium of .07, an estimate for *T* of .33, and leverage of .40. In respect of the risk free rate, previous analysis supports the choice of a term that matches the frequency with which changes in the rate are made; consequently, the use of the one year rather than the ten-year risk free rate is appropriate. In respect of the debt premium, Transpower is differentiated from the other New Zealand electricity lines businesses by its government ownership and its involvement in transmission rather than distribution. The ownership issue should be

irrelevant to assessing its cost of debt for the purposes of setting output prices, and its involvement in transmission rather than distribution would appear to exert only a trivial impact upon the debt premium. Accordingly, an appropriate estimate for Transpower's debt premium is that derived earlier for privately-owned New Zealand electricity distribution businesses, of .01 at leverage of .40. In respect of the asset beta, the regulatory regime implied by Transpower's proposal resembles that for US electric and gas utilities. Some differences are identified, and these differences suggest that the upper bound on the estimated asset beta is that for the US firms, for which an estimate of .30 is appropriate. Using this upper bound on the estimate of the asset beta, along with the estimates for the remaining parameters and the one-year risk free rate prevailing in August 2006, the estimated WACC for Transpower is .071. In addition, the standard deviation on the estimate is .011.

Had the WACC been fixed for four years rather than one year, and the regime was otherwise identical to that in Transpower's proposal, then the appropriate risk free rate to use would be that for four years rather than one year, and the upper bound on the asset beta would rise from .30 to .375. Also, if the WACC was fixed for five years rather than one year, and the regime was otherwise identical to that in Transpower's proposal, then the appropriate risk free rate to use would be that for five years rather than one year, and the upper bound on the asset beta would rise from .30 to .40.

Transpower's third Formal Settlement Proposal differed from the initial proposal in five respects. Firstly, the asset beta was raised from .35 to .40. However, this proposed change is not consistent with the annual resetting of WACC that was also envisaged in this proposal. Secondly, Transpower's estimates for leverage, the market risk premium and the tax parameter T are now .40, .07 and .33 respectively, consistent with those favoured here. Thirdly, Transpower proposes a margin of .001 on the point estimate of .073, to yield their proposed figure of .074. Although the rationale for this margin is not articulated, I agree with the general principle of a margin to deal with uncertainty over the WACC estimate. Fourthly, Transpower's proposal to reduce the company tax rate used in determining the tax deduction on interest within WACC to .30 (from 1.4.2008) is correct. However, there are further implications of this tax change for the cost of equity, and consideration of these further effects suggests that the tax parameter T within the cost of equity should also

be reduced to .30 from 1.4.2008. Fifthly, Transpower's suggestion that this tax parameter *T* be reduced accords with the conclusion just stated.

Transpower's final Formal Settlement Proposal differs from its second proposal in that it would apply to a four rather than to a five year term (from 1.7.2007), the WACC would be set for the entire four years rather than be subject to annual revision, and a separate WACC would apply to the one year term preceding 1.7.2007. Taking account of the relevant risk free rates, and the upward adjustment to WACC arising from the announced decrease in the corporate tax rate, Transpower has proposed figures of .072 for the one year period, .077 for the first year of the four year term, and .078 for the remaining years in the four year term. This paper favours a market risk premium of .07, leverage of .40, a debt risk premium of .01, and a risk free rate whose term matches the period for which the WACC is fixed. In addition, the corporate tax rate should be .33 until 1.4.2008 and .30 thereafter, and the value for the tax parameter *T* should match this. Finally, as discussed above, the upper bounds on the asset betas for the one and four year periods should be .30 and .375 respectively. Using these parameter values, the point estimates for WACC should be .071 for the one year period (with a standard deviation on the estimate of .011), .078 for the four year period until the corporate tax rate falls on 1.4.2008 (with a standard deviation on the estimate of .012), and .080 thereafter (with a standard deviation on the point estimate of .012).

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