Leverage and Transpower’s WACC

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Summary

• The Commerce Commission should use Transpower’s actual leverage when calculating Transpower’s WACC. The benefits of this approach include:

  – Of the three approaches considered by the Commission, this approach is the only one not to underestimate Transpower’s WACC on average. This makes it the only one of the three to be consistent with the new purpose statement from Part 4 of the Commerce Act 1986, which notes that regulated firms should “have incentives to innovate and to invest, including in replacement, upgraded, and new assets” (s.52A(1)(a)).

  – Any incentive Transpower might have to increase its leverage in order to raise the calculated WACC is economically insignificant. For example, the net gain to Transpower from increasing its actual leverage by ten percentage points is that its allowed rate of return increases by just 0.08% more than its actual cost of capital.

  – This approach avoids the need to estimate debt betas and the measurement error that this induces.

• If the Commission decides not to use Transpower’s actual leverage, then it should use the average of (i) Transpower’s actual leverage and (ii) the comparison firms’ average leverage. For example, if Transpower’s actual leverage is 65.6%, then the average leverage is 55%. This approach has two principal advantages:

  – On average, the WACC estimate will be almost exactly equal to Transpower’s actual WACC.

  – Transpower will have no incentive to increase its leverage in order to raise the Commission’s WACC estimate.

• Using the comparison firms’ average leverage should be rejected as it results in downward bias in the WACC estimate. This is inconsistent with the new purpose statement as this downward bias creates an incentive for Transpower to underinvest.

• Using zero leverage would be even more inappropriate as it underestimates Transpower’s cost of capital by an even larger margin on average and thereby creates an even stronger incentive to underinvest.
1 Introduction

1. I have been engaged by Transpower New Zealand Limited to advise it on the appropriate level of leverage to use when calculating its weighted average cost of capital (WACC) in the context of the Commerce Commission’s Input Methodologies project. I am providing my advice in accordance with the Code of Conduct for expert witnesses contained in the High Court Rules, and my curriculum vitae is attached as an appendix to this paper.

2. The outcome of the Commission’s WACC calculation is sensitive to the levels of several inputs, including the tax rate, the risk-free interest rate, the (tax-adjusted) market risk premium, the asset beta, the cost of debt, and leverage (that is, the value of a firm’s debt divided by the sum of its values of debt and equity). In this paper I focus on the appropriate choice of leverage, and take the Commission’s decisions regarding all other inputs as given. In particular, I adopt the Commission’s choice of a zero debt beta when transforming equity betas into asset betas and vice versa.

3. Leverage appears in the Commission’s WACC calculation in three places.

   • **Step 1.** Calculating asset betas from the individual estimated equity betas of a set of firms with systematic risk comparable to Transpower’s (the ‘comparison firms’).

   • **Step 2.** Converting the average estimated asset beta from Step 1 into an estimate of Transpower’s equity beta.

   • **Step 3.** Calculating the weighted average of Transpower’s costs of debt and equity.

The standard approach to Step 1, followed by the Commission, uses the leverage levels of the individual comparison firms. The issue that I have been engaged to comment on involves Steps 2 and 3, where the Commission proposes to use the average leverage of its comparison firms and Transpower has in the past advocated using estimates of Transpower’s actual leverage.

4. The paper is organized as follows.

   • Section 2 summarizes the Commission’s justification for its decision to use comparison firms’ average leverage in Steps 2 and 3 of the WACC calculation.

   • Although I take the Commission’s decision regarding Transpower’s cost of debt as fixed for the purposes of this report, it is necessary to understand the various components that make up the cost of debt if we are to choose a leverage level that achieves the Commission’s stated objective. Therefore Section 3 explains how the cost of debt is made up of five distinct components. I review the empirical evidence on the magnitudes of four of these components in the appendix.

   • Section 4 evaluates three existing proposals for the level of leverage. There I show that:
     - using zero leverage underestimates the WACC on average;
– using comparison firms’ average leverage also underestimates the WACC on average; and
– using Transpower’s actual leverage overestimates the WACC on average.

• Section 5 presents a new proposal, which uses a weighted average of (i) Transpower’s actual leverage and (ii) comparison firms’ average leverage. The precise weights that ensure the calculated WACC equals Transpower’s actual WACC on average depend on the relative sizes of the components that make up the cost of debt. Using a simple average—that is, setting both weights equal to 0.5—provides a very good approximation to this weighting scheme.

• Section 6 discusses Transpower’s incentive to raise leverage above appropriate levels if its actual leverage is used in Steps 2 and 3 of the WACC calculation.

• Section 7 concludes.

2 The Commission’s position

5. The Commission rejects using Transpower’s actual leverage in Steps 2 and 3 of the WACC calculation, and instead proposes to use the average leverage of its set of comparison firms.

6. The Commission provides two justifications for its decision to not use Transpower’s leverage.\(^1\) It claims that using Transpower’s own leverage would give Transpower an incentive to raise its leverage above ‘appropriate’ levels, because the calculated WACC is higher for greater levels of leverage used in Steps 2 and 3 of the calculation:\(^2\)

“If the Commission were to regard the actual leverage of regulated suppliers as a relevant consideration in deciding on the leverage assumption, such suppliers would have an incentive to increase their leverage which could be detrimental to the long-term interests of consumers by raising the risk of bankruptcy.”

The Commission also claims that using Transpower’s own leverage results in a WACC estimate that is wrong on average (that is, it is ‘statistically biased’):\(^3\)

“It is not appropriate to use actual leverage for any regulated supplier as this would introduce the same technical issues into the estimation of the cost of capital that PwC identified with the issue of notional leverage across different services. That is, using any leverage assumption other than that of the comparative firm sample for estimating the asset beta, would bias the estimate of the cost of capital.”

\(^1\) The Commission refers to Chapter 6 and Appendix H of the EDB/GPB Reasons Paper for discussion of its decisions regarding leverage and Transpower’s WACC calculation. (See para 5.4.5 of the Transpower Reasons Paper.)

\(^2\) EDB/GPB Reasons Paper, para 6.6.5.

\(^3\) EDB/GPB Reasons Reasons, para H3.63.
7. The Commission provides two analogous justifications for its decision to use the average leverage of its set of comparison firms. By using a leverage level that is independent of Transpower’s actual leverage, the Commission ensures that Transpower cannot affect the calculated WACC by altering its leverage. In addition, the Commission claims that using comparison firms’ average leverage eliminates statistical bias in its WACC estimate:4

"On the issue of bias, the Commission notes that if the leverage of the individual entities from the sample of comparative firms is used when de-levering the respective entity’s equity beta and the average leverage of the sample of comparative firms is used in the re-levering of the average estimated asset beta, then the resulting WACC estimate will not be biased (upwards or downwards) even if the debt beta is set at zero."

8. I believe that the Commission’s concerns about Transpower’s incentive to raise its leverage in order to increase the calculated WACC are misplaced. The Commission is correct to note that if actual leverage is used in Steps 2 and 3 of the calculation then the calculated WACC is an increasing function of actual leverage. However, the Commission does not appear to appreciate the fact that the actual WACC is also an increasing function of leverage.5 The strength of any incentive to increase leverage above efficient levels therefore depends on the net gain (that is, calculated WACC minus actual WACC). For example, if the actual WACC increases by the same amount as the calculated WACC then Transpower has no incentive to change leverage. I discuss this in more detail in Section 6, where I show that the adverse incentives from using Transpower’s actual leverage will be weaker than the Commission suggests.

9. The Commission’s claim that using the comparison firms’ average leverage eliminates statistical bias is incorrect. As I explain in Section 4, the Commission’s proposed approach results in WACC estimates that are too low on average. That is, they will be biased downwards.

3 Decomposing the cost of debt

10. The Commission calculates the cost of debt as the sum of the risk-free interest rate, the ‘debt premium’, and compensation for the cost of issuing debt.6 The debt premium can be further decomposed into the sum of

- the ‘risk premium’, which is the average rate of return that investors earn from holding bonds minus the risk-free interest rate; and
- the ‘expected default loss’, which is the difference between the rate of return that investors will earn if the issuing firm does not default on the debt and the average rate of return when the possibility of default is factored into the calculation.

4EDB/GPB Reasons Paper, para H3.49

5This is in spite of the Commission’s own advisor noting, in a report to the Commission, that “…the upward effect … is an overstatement of the true situation but a properly defined WACC would still rise with leverage due to the relative illiquidity of corporate bonds and the presence of bankruptcy costs.” (Lally, 2009, p. 5).

In turn, the risk premium can be decomposed into the sum of\textsuperscript{7,8}

- compensation for bearing the systematic risk that is associated with corporate bonds (‘systematic risk premium’); and
- compensation for bearing the liquidity risk that is associated with corporate bonds (‘illiquidity premium’).

11. This gives the five distinct components shown in Figure 1, which, when added together, comprise the cost of debt.\textsuperscript{9} They can be grouped together in various ways. For example:

- Transpower’s cost of debt is the sum of the rate of return promised to investors and the cost of issuing the debt in the first place.
- The promised rate of return equals the sum of the expected rate of return and the expected default loss.
- The cost of debt exceeds the risk-free interest rate by an amount equal to the systematic risk premium (the “CAPM” component) plus the sum of the three other components (the “non-CAPM” component).

12. I will demonstrate in Section 4 that the size and sign of the average estimation error in the Commission’s WACC calculation depends on the relative sizes of the

\textsuperscript{7}This decomposition is consistent with the Commission’s approach to calculating the cost of debt: “The debt premium reflects the additional risk an investor is exposed to when lending to a borrower other than the government. The size of the debt premium principally depends on the creditworthiness of the borrower, but also reflects the inferior liquidity of corporate bonds relative to Government bonds.” (EDB/GPB Reasons Paper, para 6.3.21)  
\textsuperscript{8}A third component arises in U.S. corporate bond yields, reflecting the fact that interest payments on corporate bonds are taxed at the state level whereas interest payments on government bonds are not (Campello et al., 2008; Elton et al., 2001; Liu et al., 2007). This tax premium is potentially relevant when estimating U.S. debt betas using the decomposition approach, but is not otherwise relevant for the issues I consider in this paper.  
\textsuperscript{9}This decomposition is not controversial. See, for example, Competition Commission (2007).
CAPM and non-CAPM components of the cost of debt. Therefore, I have reviewed the most useful empirical evidence from the academic literature and used it to estimate the sizes of the four components of the cost of debt that make up the CAPM and non-CAPM components. This review, contained in Appendix A.3, suggests that the systematic risk premium comprises approximately 55% of the debt premium for five-year BBB-rated corporate bonds, the illiquidity premium comprises another 15%, and the expected default loss comprises the remaining 30%.

13. In its December 2010 decision, the Commission set the debt issuance cost equal to 0.35% and stated that “the estimate of a 2.0% p.a. debt premium for a BBB+ rated bond is appropriate in the Commission’s view.” (para H5.98) As stated above, my approach in this paper is to take the Commission’s non-leverage decisions as given. Consistent with this, I divide the 2.0% debt premium amongst the systematic risk premium, illiquidity premium, and expected default loss in the proportions reported in paragraph 12 above. My review of the existing academic literature suggests that reasonable estimates of these components are a systematic risk premium of 1.1%, an illiquidity premium of 0.3%, and an expected default loss of 0.6%.

14. The estimates that I adopt here imply that for five-year BBB+-rated bonds, the CAPM component of the cost of debt equals 1.10% and the non-CAPM component equals 1.25%.

4 Evaluation of various leverage choices

15. I now use these estimates of the components of the cost of debt to evaluate various proposals for the level of leverage the Commission should use when calculating Transpower’s cost of capital.

4.1 Zero leverage

16. The Major Electricity Users’ Group (MEUG) has advocated using zero leverage in Steps 2 and 3 of the WACC calculation (Ireland, 2010).

17. However, as I show in Appendix A.1, this approach underestimates Transpower’s WACC by

\[
\left(1 - \left(\frac{\text{tax rate}}{\text{leverage}}\right)\right) \times \left(\frac{\text{Transpower’s non-CAPM component}}{\text{leverage}}\right) + \left(\frac{\text{Compco’s leverage}}{\text{Compco’s CAPM component}}\right).
\]

That is, MEUG’s suggested approach underestimates Transpower’s WACC unless the non-CAPM component of Transpower’s cost of debt is zero and the average CAPM component of the comparison firms’ cost of debt is zero. These conditions require that the systematic risk premium is zero and the illiquidity premium is zero and the expected default loss is zero and the debt issuance cost is zero. However, none of these conditions are met.

10Given the Commission’s tax-adjusted market risk premium of 7.0% and tax rate of 28%, this level of the systematic risk premium is consistent with a debt beta of 0.11.
18. Furthermore, the zero-leverage approach advocated by MEUG not only underestimates Transpower’s WACC, it does so by a considerable margin. For example, assuming a tax rate of 28%, average comparison firm leverage of 44%, Transpower leverage of 65.6%, a CAPM component of 1.10%, and a non-CAPM component of 1.25%, using zero leverage in Steps 2 and 3 of the WACC calculation would underestimate Transpower’s WACC by 0.94%.11

### 4.2 Comparison firms’ average leverage

19. The Commission claims that using comparison firms’ average leverage in Steps 2 and 3 of the WACC calculation results in an estimated WACC that equals Transpower’s actual WACC on average. However, as I show in Appendix A.1, this approach actually underestimates Transpower’s WACC by

\[
(1 - \text{tax rate}) \times \left( \frac{\text{Transpower’s leverage}}{\text{Compco’s leverage}} - 1 \right) \times \left( \frac{\text{Transpower’s non-CAPM component}}{\text{Compco’s non-CAPM component}} \right) - \left( \frac{\text{Compco’s leverage}}{\text{Compco’s leverage}} \times \left( \frac{\text{Transpower’s CAPM component}}{\text{Compco’s CAPM component}} - 1 \right) \right)
\]

on average. The Commission’s claim that the estimation error is zero on average will hold only under very special (and unrealistic) circumstances.

20. Assuming a tax rate of 28%, average comparison firm leverage of 44%, Transpower leverage of 65.6%, a CAPM component of 1.10%, and a non-CAPM component of 1.25%, using comparison firms’ average leverage in Steps 2 and 3 of the WACC calculation would underestimate Transpower’s WACC by 0.19%.

21. The Commission relies on a note prepared for the Electricity Networks Association (ENA) by PwC (PricewaterhouseCoopers, 2010), which itself relies on a numerical example that makes a very strong assumption: that the non-CAPM component in Figure 1 equals zero.12 This assumption is incompatible with what we know about the cost of debt. For example, my review of the empirical literature in Appendix A.3 shows that the illiquidity premium and expected default loss (two elements of the non-CAPM component) are positive and economically significant. This assumption is also inconsistent with the fact that the Commission sets the debt issuance cost (another element of the non-CAPM component) equal to 0.35%. The sum of three positive numbers—the illiquidity premium, the expected default loss, and the debt issuance cost—cannot be zero. In Appendix A.2 I show that relaxing the assumption of a zero non-CAPM component overturns the Commission’s claim that using comparison firms’ average leverage results in statistically unbiased WACC estimates.

### 4.3 Transpower’s actual leverage

22. The traditional approach to Steps 2 and 3 of the WACC calculation is to use the regulated firm’s actual leverage.

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11Note that this calculation assumes that all other inputs into the WACC calculation are correct. For example, if the Commission has underestimated Transpower’s asset beta, then using zero leverage would underestimate Transpower’s actual WACC by even more than the amount given here.

12See, for example, para H3.59 of the EDB/GPB Reasons Paper.
23. I show in Appendix A.1 that this approach overestimates Transpower’s WACC by

\[
\left(1 - \left(\frac{\text{tax rate}}{\text{Transpower's leverage}}\right)\times \left(\frac{\text{Transpower's CAPM component}}{\text{Compco's leverage}}\times \left(\frac{\text{Compco's CAPM component}}{\text{Compco's leverage}}\right)\right)\right)
\]

on average. Thus, using Transpower’s actual leverage results in statistically unbiased estimates only if the product of leverage and the CAPM component in Figure 1 takes the same value for Transpower and, on average, for the Commission’s set of comparable firms. This condition is unlikely to hold as it would require firms with high levels of leverage to have small CAPM components of the cost of debt, which is counterintuitive.

24. Assuming a tax rate of 28%, average comparison firm leverage of 44%, Transpower leverage of 65.6%, a CAPM component of 1.10% for comparison firms and Transpower, and a non-CAPM component of 1.25%, using Transpower’s actual leverage in Steps 2 and 3 of the WACC calculation would overestimate Transpower’s WACC by 0.17%.

4.4 Comparing the three alternatives

25. If the Commission decides that it must choose between one of the three options above, then it should use Transpower’s actual leverage in Steps 2 and 3 of the WACC calculation. This option results in the smallest estimation error, on average. More importantly, it is the only option that does not underestimate the WACC on average. If Transpower’s allowed rate of return is lower than its WACC, the firm will have an incentive to underinvest. This is an important consideration given the new purpose statement from Part 4 of the Commerce Act 1986, which notes that regulated firms should “have incentives to innovate and to invest, including in replacement, upgraded, and new assets” (s.52A(1)(a)).

5 A new approach: Weighted-average leverage

26. One of the Commission’s stated motivations for using comparison firms’ average leverage in Steps 2 and 3 of the WACC calculation is to eliminate statistical bias in its WACC estimate. The analysis above shows that the Commission’s proposed solution—using comparison firms’ average leverage—does not achieve this. In this section I describe the leverage level that does achieve the Commission’s stated goal.

27. The Commission could use a weighted average of (i) Transpower’s actual leverage and (ii) the comparison firms’ average leverage, with the weight attached to these two leverage levels in the same ratio as the CAPM and non-CAPM components of the cost of debt. That is, the leverage level equals

\[
\hat{L} = \frac{\text{nonCAPM}}{\text{CAPM} + \text{nonCAPM}} \times L_{\text{Transpower}} + \frac{\text{CAPM}}{\text{CAPM} + \text{nonCAPM}} \times L_{\text{Compco}}. \tag{1}
\]

When the non-CAPM component is large relative to the CAPM component, the weighted average attaches a relatively high weight to Transpower’s actual leverage and a relatively low weight to the comparison firms’ average leverage.
28. This formula applies for any combination of CAPM and non-CAPM components, but it is informative to consider two extreme cases.

- First, consider the case where the non-CAPM component equals zero, so that the cost of debt equals the risk-free interest rate plus the CAPM component. In this case, the formula in equation (1) implies that the Commission should use the leverage level \( \hat{L} = L_{\text{Compco}} \). That is, if the non-CAPM component of the cost of debt was zero, the Commission’s preferred approach of using the comparison firms’ average leverage would coincide with the weighted-average approach described in equation (1).

- Second, consider the opposite extreme, where it is the CAPM component that equals zero, so that the cost of debt equals the risk-free interest rate plus the non-CAPM component. In this case, the formula in equation (1) implies that the Commission should use the leverage level \( \hat{L} = L_{\text{Transpower}} \). That is, if the CAPM component of the cost of debt was zero, Transpower’s preferred approach of using its actual leverage would coincide with the weighted-average approach described in equation (1).

29. Now consider the general case. As described in Section 4.2, using just the comparison firms’ average leverage underestimates the WACC, and the average error is large when the non-CAPM component is large. As described in Section 4.3, using just Transpower’s actual leverage overestimates the WACC and the average error is large when the CAPM component is large. Intuitively, if the non-CAPM component is relatively large and the CAPM component is relatively small then we should attach a relatively low weight to the results from using the comparison firms’ average leverage and a relatively high weight to the results from using Transpower’s actual leverage. This is what happens when we use the weighted-average leverage in equation (1): when the non-CAPM component is large relative to the CAPM component, the weighted average attaches a relatively high weight to Transpower’s actual leverage and a relatively low weight to the comparison firms’ average leverage.

30. For example, if the CAPM component is 1.10% and the non-CAPM component is 1.25%, then equation (1) implies the leverage level

\[
\hat{L} = 1.25 \frac{1.10 + 1.25}{1.10 + 1.25} \times L_{\text{Transpower}} + 1.10 \frac{1.10 + 1.25}{1.10 + 1.25} \times L_{\text{Compco}} = 0.53 \times L_{\text{Transpower}} + 0.47 \times L_{\text{Compco}}.
\]

If Transpower’s actual leverage is 65.6% and the comparison firms’ average leverage is 44%, then this formula yields a weighted-average leverage level of 55%.

31. I show in Appendix A.1 that if the Commission uses the leverage level given in equation (1) above then this approach will overestimate Transpower’s WACC by just

\[
\left( 1 - \left( \frac{\text{tax rate}}{\text{Compco’s leverage}} \right) \right) \times \left( \frac{\text{Transpower’s CAPM component}}{\text{Compco’s CAPM component}} \right).
\]

32. If the CAPM component of Transpower’s cost of debt equals the average CAPM component of the comparison firms, then on average this approach will correctly estimate Transpower’s WACC. This is likely to be approximately the case
if Transpower and the average comparison firm have the same credit rating. In this case, the WACC calculation will be statistically unbiased.\textsuperscript{13}

33. In paragraph 30 I estimated that the weights attached to Transpower’s actual leverage and comparison firms’ average leverage should be approximately 0.53 and 0.47 respectively. However, like the other inputs in the WACC calculation, these weights are subject to measurement error. If the Commission decides to use the weighted-average approach described in this section, I believe a sensible pragmatic approach would be to use a simple average of Transpower’s actual leverage and comparison firms’ average leverage—that is, the Commission could set the weights in equation (1) equal to 0.50 and 0.50.

34. Using a simple average of the leverage levels would not completely eliminate statistical bias, but any bias remaining would be small. For example, assuming a tax rate of 28%, average comparison firm leverage of 44%, Transpower leverage of 65.6%, a CAPM component of 1.10%, and a non-CAPM component of 1.25%, using a simple average of the two leverage levels would underestimate Transpower’s WACC by 0.01%.

\section{Incentive effects}

35. The Commission claims that using Transpower’s own leverage would give Transpower an incentive to raise its leverage above ‘appropriate’ levels, because the calculated WACC is higher for greater levels of leverage used in Steps 2 and 3 of the calculation:\textsuperscript{14}

\begin{quote}
\textit{“If the Commission were to regard the actual leverage of regulated suppliers as a relevant consideration in deciding on the leverage assumption, such suppliers would have an incentive to increase their leverage which could be detrimental to the long-term interests of consumers by raising the risk of bankruptcy.”}
\end{quote}

In this section I will demonstrate that the incentives concerning the Commission are economically insignificant.

36. I show in Appendix A.1 that if actual leverage is used in Steps 2 and 3 of the WACC calculation, then changing Transpower’s actual leverage increases the calculated WACC by

$$\left(1 - \left(\frac{\text{tax rate}}{100}\right)\right) \times \left(\left(\frac{\text{Transpower's CAPM component}}{100}\right) + \left(\frac{\text{Transpower's non-CAPM component}}{100}\right)\right) \times \left(\frac{\text{Change in leverage}}{100}\right).$$

Assuming a tax rate of 28%, a CAPM component of 1.10%, and a non-CAPM component of 1.25%, this implies that if Transpower increases its actual leverage by ten percentage points, its calculated WACC increases by 0.17%. Note

\begin{footnotesize}
\begin{enumerate}
\item Even if the two CAPM components of the cost of debt are not equal, the average error will be small. For example, even if the CAPM component of Transpower’s cost of debt exceeded the average CAPM component of the comparison firms by 0.20%, this approach would overestimate Transpower’s WACC by just 0.06% on average, assuming a tax rate of 28% and comparison firms’ average leverage of 44%.
\item EDP/GPB Reasons Paper, para 6.6.5.
\end{enumerate}
\end{footnotesize}
this is consistent with Table H1 of the EDB/GPB Reasons Paper, which shows the results of the numerical example that the Commission uses to illustrate its concerns regarding the incentive effects of using actual leverage to calculate the WACC.

37. The Commission correctly points out that the estimated WACC will increase if actual leverage is raised, but it fails to note that Transpower’s actual WACC will increase as well. As I show in Appendix A.1, changing Transpower’s actual leverage increases its actual WACC by

$$
\left(1 - \left(\frac{\text{tax rate}}{100}\right)\right) \times \left(\frac{\text{Transpower’s non-CAPM component}}{100}\right) \times \left(\frac{\text{Change in leverage}}{100}\right).
$$

Assuming a tax rate of 28% and a non-CAPM component of 1.25%, this implies that if Transpower increases its actual leverage by ten percentage points, its actual WACC increases by 0.09%.

38. It is not surprising that a regulated firm’s required rate of return increases if it raises its leverage. For example, higher leverage forces the firm to raise a larger proportion of its capital in relatively illiquid bond markets and a smaller proportion of its capital in relatively liquid equity markets. Bond-market investors demand a higher premium for exposure to liquidity risk than equity-market investors, implying that the regulated firm’s revenue requirement must increase, and with it the required rate of return.\(^{15}\) This would not happen if liquidity in bond and equity markets was equal, as then the mix of debt and equity would not affect the overall illiquidity premium paid to investors by the firm. Similarly, higher leverage increases total debt issuance costs, which in turn increases the regulated firm’s revenue requirement. The Commission has chosen to compensate firms for debt issuance costs via the allowed rate of return (that is, the calculated WACC), so the greater revenue requirement implies a higher required rate of return.\(^{16}\)

39. Any incentive to increase leverage will be driven by the effect on the difference between the estimated WACC and the actual WACC. The net gain to Transpower from increasing its leverage is

$$
\left(1 - \left(\frac{\text{tax rate}}{100}\right)\right) \times \left(\frac{\text{Transpower’s CAPM component}}{100}\right) \times \left(\frac{\text{Change in leverage}}{100}\right).
$$

For example, the net gain to Transpower from increasing its actual leverage by ten percentage points is that its allowed rate of return will increase by just 0.08% more than its actual cost of capital.\(^{17}\) That is, the Commission has overstated

\(^{15}\)The Commission has explicitly recognized that this illiquidity premium is a part of the cost of debt, and hence a part of the WACC. For example: “The debt premium compensates the investor for the risk that the issuer in question may default, plus an allowance for the inferior liquidity of corporate bonds relative to government bonds.” (EDB/GPB Reasons Paper, para H2.8)

\(^{16}\)For example: “The [Input Methodology] compensates firms for debt issuance costs in the form of a fixed addition to the cost of debt, rather than an allowance in cash flows, as it provides a greater degree of certainty to firms. It also promotes a greater degree of comparability across suppliers.” (EDB/GPB Reasons Paper, para H2.11)

\(^{17}\)Note that the net gain depends only on the size of the CAPM component of the cost of debt; it is independent of the size (and interpretation) of the non-CAPM component. Assuming a tax rate of 28% and a (tax-adjusted) market risk premium of 7%, the net gain from increasing leverage by ten percentage points is zero if Transpower’s debt beta is zero, and 0.07% if its debt beta is 0.1.
by a factor of more than two the strength of Transpower’s incentive to raise its leverage. Thus, in contrast to the Commission’s claims, using Transpower’s actual leverage gives Transpower only an extremely weak incentive to raise its leverage above ‘appropriate’ levels.

40. This incentive must be evaluated against the non-WACC factors that affect a firm’s leverage decision. For example, the level of a firm’s leverage can affect the strength of management’s incentive to maximize shareholder value, the discipline imposed on management by the need to raise funds in external capital markets, the attitudes of managers and shareholders to risk, and the extent of capital rationing (Tirole, 2006). I believe that factors such as these far outweigh the small net increase in the allowed rate of return that results from even substantial increases in leverage.

41. Recall that the weighted-average leverage proposed in Section 5 ensures that the calculated WACC equals the actual WACC on average. This eliminates any incentive for Transpower to raise its leverage above efficient levels as doing so would increase its actual WACC by the same amount as the Commission’s WACC estimate on average. It is the only one of the four leverage choices to completely eliminate leverage-distorting incentives.

42. I show in Appendix A.1 that if the weighted-average leverage measure in equation (1) is used in Steps 2 and 3 of the WACC calculation, then changing Transpower’s actual leverage increases the calculated WACC by

\[
\left(1 - \left(\frac{\text{tax rate}}{\text{leverage}}\right)\right) \times \left(\frac{\text{Transpower's non-CAPM component}}{\text{Change in leverage}}\right) .
\]

Note that this is exactly the same amount as the increase in Transpower’s actual WACC. That is, Transpower’s net gain from increasing its actual leverage by ten percentage points is zero: Transpower has no incentive to raise its leverage above ‘appropriate’ levels.

7 Conclusion

43. In this paper I have evaluated four approaches that the Commission could adopt when setting the level of leverage to be used in Steps 2 and 3 of the calculation of Transpower’s WACC.

44. I believe that the Commission should use Transpower’s actual leverage in Steps 2 and 3 of the calculation of Transpower’s WACC. The benefits of this approach include:

- Of the three approaches considered by the Commission, this approach is the only one not to underestimate Transpower’s WACC on average. This makes it the only one of the three to be consistent with the new purpose statement from Part 4 of the Commerce Act 1986, which notes that regulated firms should “have incentives to innovate and to invest, including in replacement, upgraded, and new assets” (s.52A(1)(a)).
• Any incentive Transpower might have to increase its leverage in order to raise the calculated WACC is economically insignificant.

• This approach avoids the need to estimate the sizes of the individual components of the cost of debt.

45. If the Commission decides not to use Transpower’s actual leverage, then I believe that it should use the simple average of (i) Transpower’s actual leverage and (ii) the comparison firms’ average leverage that I have presented in Section 5. This approach has two principal advantages:

• If all of the other inputs into the WACC calculation have been chosen correctly then the WACC estimate will be (approximately) statistically unbiased.\(^{18}\)

• Transpower will have no incentive to increase its leverage beyond appropriate levels in order to raise the Commission’s WACC estimate.

46. Using the comparison firms’ average leverage should be rejected as it results in substantial downward bias in the WACC estimate. It is inconsistent with the new purpose statement as this downward bias creates an incentive for Transpower to underinvest.

47. Using zero leverage would be even more inappropriate as it underestimates Transpower’s cost of capital by an even larger margin on average and thereby creates an even stronger incentive to underinvest.

**Appendices**

**A.1 Proofs**

48. Suppose there are two firms, the regulated firm (firm \( r \)) and a comparison firm (firm \( c \)). The two firms have the same asset beta, \( \beta_a \), but different levels of leverage, \( L_r \) and \( L_c \). They have debt betas \( \beta_r^d \) and \( \beta_c^d \) and equity betas \( \beta_r^e \) and \( \beta_c^e \). I make the usual assumption that the corporate tax rate equals the investor tax rate, and denote the common rate \( T \). The firms’ costs of equity are

\[
k_e^r = (1 - T) R_f + \phi \beta_e^r \quad \text{and} \quad k_e^c = (1 - T) R_f + \phi \beta_e^c,
\]

where \( R_f \) is the risk-free interest rate and \( \phi \) is the (tax-adjusted) market risk premium. Their costs of debt are

\[
k_d^r = R_f + \frac{\phi \beta_d^r}{1 - T} + \pi^r \quad \text{and} \quad k_d^c = R_f + \frac{\phi \beta_d^c}{1 - T} + \pi^c,
\]

where \( \pi^r \) and \( \pi^c \) are components of the debt premium not explained by the CAPM (that is, due to sources such as illiquidity premia, the difference between expected and promised rates of return, and debt issuance costs). The two firms therefore have actual WACCs equal to

\[
w^r = (1 - L_r)k_e^r + L_r(1 - T)k_d^r \quad \text{and} \quad w^c = (1 - L_c)k_e^c + L_c(1 - T)k_d^c,
\]

\(^{18}\)This conclusion relies on the CAPM component of Transpower’s cost of debt having the same size as the average CAPM component of the comparison firms. However, even if these components are not equal, any statistical bias will be small.
respectively.

49. The firms’ asset, debt, and equity betas are related by

\[ \beta^r_e = \frac{\beta_a}{1 - L^r} - \frac{L^r}{1 - L^r} \beta^d_e \quad \text{and} \quad \beta^c_e = \frac{\beta_a}{1 - L^c} - \frac{L^c}{1 - L^c} \beta^d_e. \quad (5) \]

Note that the asset betas of the two firms are equal. Substituting (5) into (2), and substituting the result, together with (3), into (4) implies that the two firms’ actual WACCs are

\[ w^r = (1 - T) R_f + \phi \beta_a + (1 - T) L^r \pi^r \]

and

\[ w^c = (1 - T) R_f + \phi \beta_a + (1 - T) L^c \pi^c. \]

Notice that the firm’s actual WACCs depend on leverage as long as the non-CAPM component of the cost of debt is nonzero.

50. Now suppose that the Commission uses the comparison firm to estimate the regulated firm’s WACC and sets all debt betas equal to zero when performing its calculations. To simplify the exposition, also assume that the Commission is able to perfectly estimate the comparison firm’s equity beta. The Commission uses the comparison firm’s actual leverage to convert the comparison firm’s equity beta to an estimated asset beta, which equals

\[ \hat{\beta}_a = (1 - L^c) \beta^c_e. \]

51. Suppose that the Commission uses an arbitrary leverage \( \hat{L} \) in the remaining steps of its WACC calculations. The Commission’s calculated equity beta for the regulated firm equals

\[ \hat{\beta}_e^r = \frac{\hat{\beta}_a}{1 - \hat{L}} = \frac{1 - L^c}{1 - L} \beta^c_e, \]

and its calculated cost of equity equals

\[ \hat{k}_e^r = (1 - T) R_f + \phi \hat{\beta}_e^r = (1 - T) R_f + \phi \frac{1 - L^c}{1 - L} \beta^c_e. \]

The Commission’s calculated WACC for the regulated firm equals

\[ \hat{w}^r = (1 - \hat{L}) \hat{k}_e^r + \hat{L}(1 - T) k_d^c = (1 - T) R_f + \phi \beta_a - \phi L^c \beta^c_d + \hat{L} (\phi \beta^r_d + (1 - T) \pi^r), \]

which can be rewritten as

\[ \hat{w}^r = w^r + (1 - T) \left( \hat{L} \left( \frac{\phi \beta^r_d}{1 - T} + \pi^r \right) - L^r \pi^r - L^c \frac{\phi \beta^c_d}{1 - T} \right). \]

52. I consider the following special cases.

- If \( \hat{L} = 0 \) then the Commission’s calculated WACC for the regulated firm equals

\[ \hat{w}^r = w^r - (1 - T) \left( L^r \pi^r + L^c \frac{\phi \beta^c_d}{1 - T} \right). \]
• If \( \hat{L} = L^c \) then the Commission’s calculated WACC for the regulated firm equals
\[
\hat{w}^r = w^r - (1 - T) \left( \left( L^r - L^c \right) \pi^r - L^c \left( \frac{\phi \beta_d^r}{1 - T} - \frac{\phi \beta_d^c}{1 - T} \right) \right).
\]
• If \( \hat{L} = L^r \) then the Commission’s calculated WACC for the regulated firm equals
\[
\hat{w}^r = w^r + (1 - T) \left( L^r \frac{\phi \beta_d^r}{1 - T} - L^c \frac{\phi \beta_d^c}{1 - T} \right).
\]
• If \( \hat{L} = \pi^r \phi \beta_d^r (1 - T) + \pi^r \phi \beta_d^c (1 - T) \) then the Commission’s calculated WACC for the regulated firm equals \( \hat{w}^r = w^r \).

53. Partial derivatives of \( w^r \) and \( \hat{w}^r \) with respect to \( L^r \) measure the effect on Transpower’s actual and calculated WACCs of small changes in leverage.\(^{19} \) The effect on the actual WACC is given by
\[
\frac{\partial w^r}{\partial L^r} = (1 - T) \pi^r,
\]
whereas the effect on the calculated WACC is given by
\[
\frac{\partial \hat{w}^r}{\partial L^r} = \frac{\partial w^r}{\partial L^r} + (1 - T) \left( \frac{\partial \hat{L}}{\partial L^r} \left( \frac{\phi \beta_d^r}{1 - T} + \pi^r \right) - \pi^r \right) = (1 - T) \frac{\partial \hat{L}}{\partial L^r} \left( \frac{\phi \beta_d^r}{1 - T} + \pi^r \right).
\]

54. Consider the special cases above.

• If \( \hat{L} = 0 \) then
\[
\frac{\partial \hat{w}^r}{\partial L^r} = 0.
\]
• If \( \hat{L} = L^c \) then
\[
\frac{\partial \hat{w}^r}{\partial L^r} = 0.
\]
• If \( \hat{L} = L^r \) then
\[
\frac{\partial \hat{w}^r}{\partial L^r} = (1 - T) \left( \frac{\phi \beta_d^r}{1 - T} + \pi^r \right).
\]

\(^{19}\)The calculation of a partial derivative assumes that other variables are unchanged. For example, the change in leverage is assumed not to affect the size of the debt premium. The Commission makes this assumption in its numerical example in Appendix H of the EDB/GPB Reasons Paper.
If
\[ \hat{L} = \frac{\pi^r}{\phi^r_{1-T}} + \frac{\phi^r_{1-T}}{\phi^r_{1-T} + \pi^r} L^c \]
then
\[ \frac{\partial \hat{w}^r}{\partial L^r} = (1 - T)\pi^r. \]

If
\[ \hat{L} = \frac{\text{nonCAPM}^r}{\text{CAPM}^r + \text{nonCAPM}^r} L^r + \frac{\text{CAPM}^r}{\text{CAPM}^r + \text{nonCAPM}^r} L^c \]
then
\[ \frac{\partial \hat{w}^r}{\partial L^r} = (1 - T)\pi^r. \]

### A.2 PwC example

55. I repeat here the analysis in PwC’s report for ENA, for the numerical example on pp. 8–9 of that report. (Note that in the ENA piece, the regulated firm has lower leverage than the average comparison firm, so that PwC’s approach increases the final WACC figure. For Transpower’s case, the PwC approach reduces the final WACC figure.)

56. Table 1 reproduces PwC’s calculations for the special case where all of the debt premium is made up of the CAPM component. The first two columns calculate the actual WACCs for the comparison firm (‘Compco’) and for the regulated firm (‘Application’). The third column shows the Commission’s calculations of the comparison firm’s asset beta. The fourth column shows the calculations if the regulated firm’s leverage and debt premium are used to calculate the estimated WACC. The fifth column repeats these calculations for the (PwC) approach where the comparison firm’s leverage and debt premium are used to calculate the estimated WACC. As found by PwC, using actual leverage and debt premia leads to the estimated WACC deviating substantially from the actual WACC.\(^\text{20}\)

57. Table 2 repeats these calculations for the other extreme case, where all of the debt premium is made up of the non-CAPM component. Both the comparison firm and the regulated firm have the same asset beta (0.47, as in the first table). Their WACCs differ because of their different leverages and the different non-CAPM components of the debt premium. Using the regulated firm’s actual leverage and debt premium results in the correct WACC (7.45%), but now PwC’s approach gives the wrong WACC. The size of the estimation error from using PwC’s approach here is the same as from using the ‘traditional’ approach in the first case: 0.49% in both cases.\(^\text{21}\)

\(^{20}\)For this example, using actual leverage underestimates WACC. For Transpower’s case—where the regulated firm has higher leverage than the comparison firms—using actual leverage overestimates WACC.

\(^{21}\)For this example, using the comparison firm’s leverage overestimates WACC. For Transpower’s case—where the regulated firm has higher leverage than the comparison firms—using the comparison firm’s leverage underestimates WACC.
Table 1: Non-CAPM component of cost of debt is zero

<table>
<thead>
<tr>
<th></th>
<th>Compco</th>
<th>Application</th>
<th>Compco</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L = $</td>
<td>$p = $</td>
<td>$L = $</td>
<td>$p = $</td>
</tr>
<tr>
<td><strong>Risk-free rate</strong></td>
<td>5.00%</td>
<td>5.00%</td>
<td>5.00%</td>
<td>5.00%</td>
</tr>
<tr>
<td><strong>Debt premium</strong></td>
<td>2.00%</td>
<td>1.50%</td>
<td>1.50%</td>
<td>2.00%</td>
</tr>
<tr>
<td><strong>Systematic component</strong></td>
<td>2.00%</td>
<td>1.50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other component</strong></td>
<td>0.00%</td>
<td>0.00%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TAMRP</strong></td>
<td>7.50%</td>
<td>7.50%</td>
<td>7.50%</td>
<td>7.50%</td>
</tr>
<tr>
<td><strong>Debt beta</strong></td>
<td>0.19</td>
<td>0.14</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Asset beta</strong></td>
<td>0.47</td>
<td>0.47</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Leverage</strong></td>
<td>65%</td>
<td>40%</td>
<td>65%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Tax rate</strong></td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Equity beta</strong></td>
<td>1.00</td>
<td>0.69</td>
<td>1.00</td>
<td>0.58</td>
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<tr>
<td><strong>Cost of equity</strong></td>
<td>10.97%</td>
<td>8.68%</td>
<td>7.86%</td>
<td>10.97%</td>
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<tr>
<td><strong>Cost of debt</strong></td>
<td>7.00%</td>
<td>6.50%</td>
<td>6.50%</td>
<td>7.00%</td>
</tr>
<tr>
<td><strong>WACC</strong></td>
<td>7.03%</td>
<td>7.03%</td>
<td>6.54%</td>
<td>7.03%</td>
</tr>
</tbody>
</table>

Table 2: CAPM component of cost of debt is zero

<table>
<thead>
<tr>
<th></th>
<th>Compco</th>
<th>Application</th>
<th>Compco</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L = $</td>
<td>$p = $</td>
<td>$L = $</td>
<td>$p = $</td>
</tr>
<tr>
<td><strong>Risk-free rate</strong></td>
<td>5.00%</td>
<td>5.00%</td>
<td>5.00%</td>
<td>5.00%</td>
</tr>
<tr>
<td><strong>Debt premium</strong></td>
<td>2.00%</td>
<td>1.50%</td>
<td>1.50%</td>
<td>2.00%</td>
</tr>
<tr>
<td><strong>Systematic component</strong></td>
<td>0.00%</td>
<td>0.00%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other component</strong></td>
<td>2.00%</td>
<td>1.50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TAMRP</strong></td>
<td>7.50%</td>
<td>7.50%</td>
<td>7.50%</td>
<td>7.50%</td>
</tr>
<tr>
<td><strong>Debt beta</strong></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Asset beta</strong></td>
<td>0.47</td>
<td>0.47</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td><strong>Leverage</strong></td>
<td>65%</td>
<td>40%</td>
<td>65%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Tax rate</strong></td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Equity beta</strong></td>
<td>1.34</td>
<td>0.78</td>
<td>1.34</td>
<td>0.78</td>
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<tr>
<td><strong>Cost of equity</strong></td>
<td>13.57%</td>
<td>9.38%</td>
<td>9.38%</td>
<td>13.57%</td>
</tr>
<tr>
<td><strong>Cost of debt</strong></td>
<td>7.00%</td>
<td>6.50%</td>
<td>6.50%</td>
<td>7.00%</td>
</tr>
<tr>
<td><strong>WACC</strong></td>
<td>7.94%</td>
<td>7.45%</td>
<td>7.45%</td>
<td>7.94%</td>
</tr>
</tbody>
</table>

58. Table 3 considers a more realistic situation than these two extremes. Here the CAPM and non-CAPM components make up 47% and 53% of the debt premium, respectively. Both the regulated firm and the comparison firm have asset betas of 0.47, as in PwC’s original example. The magnitude of the estimation error from using PwC’s approach is slightly greater than the magnitude of the estimation error from using the ‘traditional’ approach: 0.26% versus 0.23%. PwC’s approach overestimates the regulated firm’s WACC and the traditional approach underestimates it. However, note that this would be reversed in Transpower’s case, where the comparison firms have relatively low leverage.

22This is consistent with my estimates used elsewhere in this paper, where the CAPM and non-CAPM components equal 1.10% and 1.25% respectively.
Table 3: CAPM and non-CAPM components comprise 47% and 53% of debt premium

<table>
<thead>
<tr>
<th></th>
<th>Compco</th>
<th>Application</th>
<th>Compco</th>
<th>Application</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>$L = $</td>
<td>$L = $</td>
<td>$p = $</td>
<td>$p = $</td>
</tr>
<tr>
<td>Risk-free rate</td>
<td>5.00%</td>
<td>5.00%</td>
<td>5.00%</td>
<td>5.00%</td>
</tr>
<tr>
<td>Debt premium</td>
<td>2.00%</td>
<td>1.50%</td>
<td>1.50%</td>
<td>2.00%</td>
</tr>
<tr>
<td>Systematic component</td>
<td>0.94%</td>
<td>0.70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other component</td>
<td>1.06%</td>
<td>0.80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAMRP</td>
<td>7.50%</td>
<td>7.50%</td>
<td>7.50%</td>
<td>7.50%</td>
</tr>
<tr>
<td>Debt beta</td>
<td>0.09</td>
<td>0.07</td>
<td>0.00</td>
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<tr>
<td>Asset beta</td>
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<td>0.47</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Leverage</td>
<td>65%</td>
<td>40%</td>
<td>65%</td>
<td>40%</td>
</tr>
<tr>
<td>Tax rate</td>
<td>30%</td>
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<td>30%</td>
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<tr>
<td>Equity beta</td>
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<td>1.18</td>
<td>0.69</td>
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<tr>
<td>Cost of equity</td>
<td>12.35%</td>
<td>9.05%</td>
<td>8.67%</td>
<td>12.35%</td>
</tr>
<tr>
<td>Cost of debt</td>
<td>7.00%</td>
<td>6.50%</td>
<td>6.50%</td>
<td>7.00%</td>
</tr>
<tr>
<td>WACC</td>
<td>7.51%</td>
<td>7.25%</td>
<td>7.02%</td>
<td>7.51%</td>
</tr>
</tbody>
</table>

A.3 The magnitude of the components of the debt premium

59. In this section I summarize the relevant academic literature on the magnitude of the components of the debt premium. This literature looks mostly at U.S. corporate bonds, so I focus on studies using U.S. data. This requires consideration of an additional component of the debt premium, which I refer to here as the tax premium. This reflects the fact that interest payments on corporate bonds are taxed at the state level whereas interest payments on government bonds are not (Campello et al., 2008; Elton et al., 2001; Liu et al., 2007).

60. The papers below provide estimates of various combinations of the systematic risk premium, illiquidity premium, expected default loss, and tax premium, which I denote $S$, $I$, $E$, and $T$, respectively.

61. I consider the following papers:

- Almeida and Philippon (2007) report estimates for four-year BBB-rated bonds (Table II) that imply

$$S + E = 0.724(S + I + E + T).$$

- Chen et al. (2009) report results for four-year BBB-rated bonds that imply

$$S + E = 0.702(S + I + E + T).$$

- Dick-Nielsen et al. (2012) use data from the pre-subprime period (2005Q1–2007Q1) and estimate that the illiquidity premium for typical 4–5 year corporate bonds comprises 13% of the debt premium and for typical BBB-rated corporate bonds it comprises 8% of the spread. During the post-subprime period (2007Q2–2009Q2) these figures rise to 31% of the debt premium for typical 4–5 year corporate bonds and 29% of the debt premium for typical BBB-rated corporate bonds, from which I take

$$I = 0.30(S + I + E + T).$$
Dionne et al. (2010) use a variety of techniques to estimate the size of the expected default loss as a percentage of the yield spread for Baa-rated bonds issued by industrial firms. For the most recent sample period they study (1992–1996), typical results are 12.60% (with a standard error of 4.05%) for two-year bonds and 35.35% (with a standard error of 6.05%) for ten-year bonds (Table XIII). Linearly interpolating the results for two- and ten-year bonds in Table XIII implies that

\[ E = 0.211(S + I + E + T) \]

for five-year bonds.

Elton et al. (2001) report estimates for five-year BBB-rated bonds issued by industrial firms that imply

\[ E + T = 0.499(S + I + E + T) \quad \text{and} \quad E = 0.209(S + I + E + T). \]

The U.K. Competition Commission based its estimate of the expected default loss on the results in this paper (Competition Commission, 2007, Appendix F).

Liu et al. (2007) estimate the tax premium of five-year BBB-rated bonds. The results in Table 7 of their paper imply that

\[ T = 0.3753(S + I + E + T). \]

Longstaff et al. (2005) use data on credit default swaps to decompose credit spreads into default and non-default components. The results in Table IV of their paper imply that

\[ S + E = 0.71(S + I + E + T) \]

for five-year BBB-rated bonds.

62. No combination of \( S, I, E, \) and \( T \) simultaneously satisfies all of the equations above. Therefore I look for a combination that minimizes the (unweighted) sum of squared errors of all equations, subject to the condition that \( S + I + E + T = 1 \).

This implies that

\[ S = 0.422, \quad I = 0.118, \quad E = 0.229, \quad T = 0.231. \]

For example, this approach implies that the tax premium comprises approximately 23.1% of the total debt premium for BBB-rated U.S. corporate bonds. N.Z. corporate bonds do not have the same tax disadvantage relative to government bonds as U.S. corporate bonds, and should therefore have no tax premium. For this reason, I assume that the spread on a N.Z. corporate bond is divided between the systematic risk premium, the illiquidity premium, and the expected

\[ \text{Of course, other weighting schemes are possible. For example, equations for which the coefficients are more precisely estimated might be awarded a higher weight, but standard errors are not generated by the estimation approaches used in some of the studies considered here. Equations that were estimated using more recent data might also be weighted more heavily. However, such complexity could quickly lead to a misleading sense of precision in the final estimates, and is not pursued here.} \]
default loss in the ratio $S:I:E$. This implies that the systematic risk premium comprises approximately 55% of the debt premium for five-year BBB-rated N.Z. corporate bonds, the illiquidity premium comprises another 15%, and the expected default loss comprises the remaining 30%.

63. In its December 2010 decision, the Commission stated that “the estimate of a 2.0% p.a. debt premium for a BBB+ rated bond is appropriate in the Commission’s view.” (para H5.98) As stated above, my approach in this report is to take the Commission’s non-leverage decisions as given. Consistent with this, I divide the 2.0% debt premium amongst the systematic risk premium, illiquidity premium, and expected default loss in the proportions above, implying a systematic risk premium of 1.1%, an illiquidity premium of 0.3%, and an expected default loss of 0.6%.

References


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24This is a strong assumption, but some such assumption is inevitable if we are to use overseas data to estimate the size of the components of N.Z. firms’ costs of debt. It is possible that N.Z. corporate bonds will have a greater proportional illiquidity premium than comparable U.S. bonds. If this increase comes at the expense (at least partially) of the systematic risk premium, then my calculations here will overestimate the size of the CAPM premium in Transpower’s cost of debt. I am not aware of any credible research that offers useful insights into the relative illiquidity premia in the US and NZ.


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Curriculum Vitae  
April 4, 2012

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Email graeme.guthrie@vuw.ac.nz

Education


1986–1988 Bachelor of Science (First Class Honours) in Mathematics, University of Canterbury.

Employment

2006–Present Professor, School of Economics & Finance, Victoria University of Wellington.

2005 Associate Professor, School of Economics & Finance, Victoria University of Wellington.

1999–2004 Senior Lecturer, School of Economics & Finance, Victoria University of Wellington.

1995–1998 Lecturer, Department of Economics, University of Canterbury.

1994 Tutor, Department of Economics, University of Canterbury.


Research Interests


Teaching Experience

Corporate finance; derivative pricing; financial economics. Microeconomics. Macroeconomic theory.
RESEARCH

Book


Papers in refereed journals


Papers in refereed conference proceedings


Publicly available commissioned reports

“A supplementary note on measurement error and regulated firms’ allowed rates of return” (November 2010).
Available at http://www.transpower.co.nz

“Measurement error and regulated firms’ allowed rates of return” (August 2010).
Available at http://www.comcom.govt.nz

Available at http://www.comcom.govt.nz

“Further notes on incorporating real options in regulated prices” (December 2009).

“Incorporating real options in regulated prices” (August 2009).

“Comments on Castalia’s ‘Discount Rate for the Grid Investment Test’” (November 2006).
Available at http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/Feb07-decision

Available at http://www.iscr.org.nz

“Real options and transmission investment: the New Zealand Grid Investment Test” (February 2006, with Glenn Boyle and Richard Meade).
Available at http://www.iscr.org.nz

Available at http://www.comcom.govt.nz/IndustryRegulation/Telecommunications

Available at http://www.comcom.govt.nz/IndustryRegulation/Telecommunications

“TSLRIC and the cost of capital: Further comments” (April 2003, with Neil Quigley).
Available at http://www.comcom.govt.nz/IndustryRegulation/Telecommunications

“A conservative estimate of the required increment to the WACC for the TSO” (September 2002, with Neil Quigley).
Available at http://www.comcom.govt.nz/IndustryRegulation/Telecommunications
Available at http://www.iscr.org.nz

**Miscellaneous**


“One filming to bind them” (with Steen Videbeck). *ISCR Competition and Regulation Times* (April 2002).

“Unbundling the debate over bundling in the dairy industry” (with Lew Evans). *ISCR Competition and Regulation Times* (April 2002).

“Milking the system for fair shares” (with Lew Evans). *New Zealand Herald* (March 15, 2002).


**TEACHING**

**Advanced Undergraduate**

- **2006–2010** Financial Economics
- **1999–2003** Corporate Finance, including capital budgeting, real options, agency theory, and signalling theory
- **1996–1998** Financial Economics, developing and testing a wide range of asset pricing models, starting from first principles
- **1995** Macroeconomic Theory, including rational expectations, asset pricing models

**Graduate**

- **2012** Corporate Governance
- **2009–2010** Corporate Finance
- **2005–2010** Real Options

1995–2004 Microeconomic Theory, including mathematical economics, decision-making under uncertainty, information economics, financial intermediation, market microstructure

1995 Macroeconomic Theory, mainly applications of optimal control theory.

Post-experience

2010 Real Options (Master of Applied Finance)


1999–2003 Corporate Finance, including capital budgeting, real options, agency theory, and signalling theory (Master of Business Administration; Master of Applied Finance)

PROFESSIONAL ACTIVITIES

Editorial Board

2009–2011 New Zealand Economic Papers

Refereeing


**Doctoral Thesis Examiner**

2006  Victoria University of Wellington

2006  University of Canterbury

2002  University of Auckland

2002  Victoria University of Wellington

**Masters Thesis Examiner**

2010  University of Auckland

2010  Victoria University of Wellington

2006  Victoria University of Wellington

2004  University of Otago

2002  Victoria University of Wellington

1998  University of Otago