



FINAL REPORT

TSLRIC Pricing: Financial Issues

Submitted to

**Ken Stephen
Telecom NZ Ltd
PO Box 570
Wellington**

Prepared by:

**Charles River Associates (Asia Pacific) Ltd
Level 11, Mobil on the Park, 157 Lambton Quay
PO Box 1123, Wellington, New Zealand
Tel: + 64 4 473 5080 Fax: + 64 4 473 5090**

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1. INTRODUCTION

1. The Telecommunications Act provides for the Commission to utilise a total service long-run incremental cost (TSLRIC) pricing methodology in determinations of the price for interconnection services on the fixed public switched telephone networks (PSTNs). Given the high proportion of fixed costs associated with any calculation of the TSLRIC of interconnection, the calculation of a reasonable return on the capital invested in the PSTN will be a particularly important input into any such calculation.
2. Telecom New Zealand has asked Charles River Associates (CRA) to review and provide comments on the Commerce Commission's discussion paper "Application of a TSLRIC Pricing Methodology (2 July 2002)". In this paper we focus on the issues relating to the determination of a reasonable return on the capital employed and in particular those issues covered in Chapter 8 of the Commission's paper.

2. WEIGHTED AVERAGE COST OF CAPITAL

3. The Commission seeks comment on the appropriate form of the weighted average cost of capital (WACC) and the capital asset pricing model (CAPM). We consider that it is appropriate to use a standard WACC calculation together with the Brennan-Lally form of the CAPM. This combination of models is widely adopted by practitioners in corporate finance in New Zealand, and also reflects the position adopted by the Commerce Commission in past decisions.
4. We agree that a WACC should be estimated on a post-tax basis, and that taxation liabilities should be estimated as a separate cost. This is consistent with the use of the Brennan-Lally CAPM and vanilla WACC, is standard practice in New Zealand, and reflects the post-tax returns required by investors (so is invariant to changes in the taxation regime).
5. Whatever version of the WACC is calculated the Commission should bear in mind that the discount rate obtained is an estimate that is based on strong assumptions about both the theory and the data that may be used in the calculation. For example:
 - Use of the WACC assumes that the pricing kernel (the adjustment factor for converting future cash flows into a present value) for all future cash flows can be captured by a single risk-adjusted discount rate. However, inter-temporal asset pricing theory makes it clear that this will be the case if and only if either (a) investors are risk-neutral (see, for example, Cochrane, 2001), in which case the discount rate is simply a maturity-invariant riskless rate so that the application of a single discount rate to all future cash flows is inconsistent with *any* risk adjustment, or (b) capital market investment opportunities obey very strong stationarity conditions (Fama, 1977).
 - Even if one is prepared to ignore this problem by assuming that inter-temporal fluctuations in the relevant state variables are sufficiently small to obviate the need for time-varying discount rates, the WACC calculation is simply a rough-and-ready method of capturing the interaction between investment and financing that is due to tax effects.
6. From a practical point of view this means that calculations of the WACC do not remove the requirement from the Commission to exercise judgement. As Brealey and Myers (1991, p408) point out, "...the WACC is at best a starting point for setting discount rates". In respect of the Telecommunications Act, the Commission is required to determine a reasonable return on capital invested, and in addition, to interpret what is "reasonable" in the context of the need to create a dynamically-efficient environment that will promote the long-term interests of end users.

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2.1. RISK-FREE RATE

7. Due to the central role of the risk-free rate of interest in the CAPM, the Commission seeks comment on the appropriate bond maturity for estimating this rate.
8. In the CAPM, the required expected return on any risky asset over a given time period is given by a weighted sum of (i) the expected return on the market portfolio of risky assets and (ii) the riskless rate of return on a zero-coupon bond *over the same time period*, where the weights are beta and (1-beta) respectively. Since application of the CAPM usually focuses on 1-year expected returns, *the only internally consistent bond rate is the 1-year zero-coupon rate*. Any other bond is not riskless over the 1-year period.¹
9. However, a 1-year zero-coupon rate is strictly applicable only to cash flows that accrue one year hence. Even if the joint distribution of risky asset returns is stationary (so that the risk premium term in the CAPM is independent of maturity), the riskless rate varies with maturity unless the yield curve is flat. This implies that, even in a CAPM world, the appropriate maturity for the riskless rate depends on the maturity of the cashflows being discounted, i.e., the x-year zero-coupon rate is applicable to x-year cash flows.
10. One way of incorporating this point, while still maintaining the fiction of a single risk-adjusted discount rate applicable to all future cash flows, is to use the current rate offered by a government bond of the same maturity as the asset (as suggested by the Commission at paragraph 260). Because such a bond is equivalent to a portfolio of zero-coupon bonds, its yield is a complex average of the entire structure of zero-coupon rates over the life of the asset. In this respect at least, it incorporates all relevant zero-coupon rates.
11. For the same reason, it is in our view difficult to justify the suggestion in paragraph 261 that the bond maturity be set equal to the duration of the Commission's determination. Where this differs from the asset life, the bond yield will be based on an incomplete set of zero-coupon rates.

2.2. MARKET RISK PREMIUM

12. Another central player in the CAPM is the market risk premium. The standard approach for estimating this parameter is to calculate an historical average. The Commission (Table 4) provides a number of examples of this approach, providing estimates ranging from 7.1% to 9%.

¹ The Commission makes a similar point at paragraph 262.

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13. The most important issue in respect of the use of these market risk premiums in any determination by the Commission is the fact that, despite the widespread agreement on this range as the appropriate arguable range, the statistical evidence in support of this range is relatively weak. The standard deviation of stock returns is so high that standard confidence intervals for the expected stock market return are in the range of about 3% to about 13%.
14. The lack of statistical certainty about the market risk premium once again suggests that the Commission will be required to exercise judgement in its determination, and that judgement will of course be driven by the Purpose Statement set out in the Telecommunications Act. Following arguments presented to the Commission in earlier papers, it is our view that the cost (in terms of impairment of dynamic efficiency) of understating the market risk premium will be much higher than the cost of overstating the premium. This is because a premium that is too low may mean that the network does not attract any new investment since no firm may be prepared to accept the returns available on new investment at the regulated TSLRIC.

2.3. COST OF DEBT

15. The two approaches suggested by the Commission for estimating the cost of debt involve using actual market yields, in one case the yield offered by the bonds of the access provider, in the other the yield offered by the bonds of a comparable firm. We consider this approach to be reasonable if an appropriate benchmark firm can be found, but therein lies the problem. The relevant cost of debt is the cost of debt for a regulated provider of interconnection services, not the cost of debt for Telecom. This is because Telecom is larger and more diversified than the provider of interconnection services could plausibly be, and because this factor is likely to outweigh any benefits of isolating the impact of other high risk aspects of this business of the integrated firm. The cost of debt for a regulated interconnection provider will therefore be higher than the cost of debt for Telecom as a whole.

2.4. BETAS OF NEW ZEALAND UTILITIES AS A GUIDE TO THE BETA OF THE PSTN

16. In paragraph 300 the Commission suggests that possible benchmarks for fixed PSTNs are utilities such as electricity and gas companies. The comparison is based on the suggestion that “the demands for electricity, gas and telephony services are similar insofar as their use is ubiquitous and their income elasticities or demand are small” and “the characteristics of the costs of providing these services are similar, involving a high proportion of fixed costs”. We doubt that the betas estimated for electricity and gas companies provide a useful benchmark for telecommunications companies. This is because the elasticity of demand for some of the services supplied over the PSTN is high – for example dial-up data services, call minder, long distance calls – whereas the elasticity of demand for electricity and gas services is relatively low. This suggests that the systematic risk associated with telecommunications services may be much more highly correlated with the risk of the market as a whole, and thus that beta may be substantially higher.
17. Gas and electricity companies will also vary from telecommunications companies in respect of the reasonable return on capital employed because of the difference in the asymmetric risks that they face. The rate of technical change in telecommunications makes the risk of bypass and technical redundancy much higher than it is in the electricity and gas industry. In addition, this implies that the range and the value of the options available to an unregulated telecommunications company are much higher than those associated with gas and electric companies.

2.5. CONSISTENCY WITH THE AIRPORT DECISION

18. Consistency between current and past decisions by the Commission is certainly helpful to market participants, but should not be a pre-eminent goal of each decision by the Commission. Since it would not be dynamically efficient to compound any errors that might exist in past decisions, issues relating to the cost of capital must be open for reconsideration at each decision.

3. ASYMMETRIC RISKS

19. The Commission suggests that two additional factors, termed “asymmetric risks”, are not captured by the CAPM because that model allows only symmetrically-distributed returns.
20. While it is true that a standard application of the CAPM and WACC will ignore these factors, this is not related to any asymmetry of returns. If, for example, the correct pricing model is the inter-temporal CAPM, then return factors are log-normally distributed and thus asymmetrically distributed. But both truncated returns and investment timing flexibility still increase the hurdle rate for profitable investment. Or, to put it another way, the CAPM may be a perfect indicator of equilibrium expected returns, but these returns still require adjustment for the “asymmetric risks”. In short, the relevance of either “asymmetric risk” for efficient capital investment policy has nothing to do the validity or otherwise of the CAPM and symmetric return distributions.²

3.1. TRUNCATED RETURNS

21. In deciding whether or not to invest, an unregulated firm faces a range of possible outcomes. Some are good, with high returns. Some are bad, with low returns. The *expected* return is the mathematical mean of these return outcomes. If this expected return exceeds the cost of capital (as determined, say, by the CAPM), then investment proceeds; otherwise it does not. The Commission appears to be referring to the situation whereby *regulation* permits the firm to earn no more than the cost of capital in the good outcomes, while providing no protection against the low returns in the bad outcomes. In this sense, the risk is asymmetric, the result being that the actual expected return on investment *must* be less than the cost of capital.³ Note that this is a strictly mathematical result that holds regardless of the methods used to determine the cost of capital.

² Indeed, the seminal treatment of the optimal investment timing policy (McDonald and Siegel, 1986) assumes that the CAPM holds.

³ This point is discussed at length by Kolbe, Tye and Myers (1993).

22. The Commission notes that in Victoria, Australia, a recent determination by ORG states that "...in competitive markets, competition regulates the upside potential, while the potential for losses is unbounded". However, the diversity of views that underlie individual firm decisions about the minimum return that they will accept to operate in a market, and the fact that the solvency of their company may depend on the quality of their assessment, makes the operation of a competitive market quite unlike the situation in which a regulatory determination is made. In particular, the discipline that competition imposes on the up-side potential will be consistent with the distribution of returns expected by market participants, but the return set by a regulator may not have the same consistency.

3.2. OPTION TO DELAY INVESTMENT

23. The Commission appears to be arguing that because the option to delay investment is valuable, removal of this option by the regulatory process requires compensation via, for example, an allowed rate of return that exceeds the WACC. This logic implies that a firm that retained the delay option would not require any rate of return above the WACC. In our view this represents a misunderstanding of real options theory.
24. Part of the confusion may have arisen because the Commission appears to view the delay option as a contributor to the *cost* of capital used in investment. In fact, it is a contributor to the quantity or value of capital used in investment. When a firm has an option to invest in a project, it effectively holds the "rights" to that project. Although these rights are intangible prior to investment, they are nevertheless valuable because they give the firm the opportunity to begin the project at the most favourable date. Rational investors recognise this and bid up the firm's share price now, i.e., the firm's market value rises. This adds to the value of capital employed in the project, so in order for investment to begin, the project must earn the cost of capital (e.g., the WACC) not only on the direct investment cost, but also on this additional capital value. If this were not the case, firm value would decline because some capital used in the project would be earning less than its cost. To put it another way, the flexibility to delay investment allows the firm to begin investment only when economic conditions are favourable, but the increase in potential payoff created by this flexibility causes investors to provide more capital (i.e., bid up the share price) now, thereby increasing the quantity of capital used in the project.
25. To reiterate, the flexibility to delay investment increases the value of the firm's capital, so when this flexibility is given up (by investing), this additional capital is "used up" and must therefore earn the cost of capital. The direct way of capturing this effect is to calculate the value of the additional capital, but a mathematically equivalent way is to increase the project discount rate. However, and it is important to be clear on this, the discount rate "premium" is *not* an adjustment for additional risk, but merely a mathematical means of capturing the additional capital employed in the project. This can be seen directly in the McDonald and Siegel (1986) investment-timing rule: investment should proceed if and only if

$$V \geq \frac{\beta I}{1 - \beta}$$

26. where V is project value, I is the direct investment cost, and $\beta > 1$ is a constant reflecting the value of timing flexibility. This condition makes it clear that flexibility increases the quantity of capital which V has to recover. Equally clearly, this condition could be re-stated as a premium-on-WACC requirement, but this should not be interpreted as an additional risk premium.
27. This premium means that the optimal investment policy is not to invest at the break-even point but to invest as soon as the value of the project exceeds a threshold which is strictly greater than the cost of the project. If the firm invests at the break-even point, its owners are contributing both the cost of the project and the cost of foregoing the option to invest later. This means that the return on capital must be the required return on the total contribution of shareholders, not just the WACC on the cost of the project.

3.3. NEGATIVE RETURNS

28. An additional factor the Commerce Commission may want to consider is the role of unsystematic risk. The NPV/WACC/CAPM approach asserts that only systematic risks are relevant for determining the cost of capital. But even if this is true, unsystematic risk may still have a role to play by affecting the quantity of capital used in investment.
29. When a firm takes on a high-risk project, it becomes more likely that it will generate very negative returns in the future. Because negative returns potentially weaken the firm's financial position, this increases the likelihood that it will be subject to a financing constraint in the future (see Stulz, 1999). This, in turn, makes it less likely that it will be able to fund future valuable investment opportunities. This reduces the current value of those investment opportunities, thereby eliminating some of the firm's capital. For investment to be justified, it must therefore earn the cost of capital not only on the direct investment costs, but also on this sacrificed capital. The high-risk nature of telecommunication investments make this a relevant issue for TSLRIC.

3.4. MARKET POWER

30. The Commerce Commission seems willing to compensate Telecom for the loss of timing options resulting from regulation (paragraph 357) unless their existence is an artefact of market power (paragraph 363). In this context it is important to be clear that timing options do not disappear under competition and are not reliant on market power for their existence. Dixit and Pindyck (1994) model a situation where two firms compete to invest in a project with large sunk costs and demand uncertainty. They show that "...the firm contemplating being the first to invest recognizes that future entry by the other firm will reduce the upper end of the distribution of profit flows. Therefore it requires enough of a current premium in compensation. ... [T]he expected present value of the firm at this point is positive." (1994: 313) In short, even competing firms will not invest until the NPV is greater than some positive threshold. They argue that this threshold is a decreasing function of the number of competing firms.
31. In Dixit and Pindyck's model, the second firm must incur the same fixed cost as the first firm before it can enter the market. A more realistic set-up might be for the second firm to be able to use the first firm's network, thus avoiding paying this fixed cost. This is likely to lead to the second firm investing much sooner than in the Dixit and Pindyck model. From the point of view of the first firm, it will have the market to itself for an even shorter period, and will therefore require an even greater current premium before it is willing to invest. Thus, modifying the Dixit and Pindyck model to allow network sharing or a range of other regulatory approaches to the promotion of entry will result in the investment threshold (in NPV terms) being even higher. Conversely market power (resulting from high barriers to entry) could result in investment by the incumbent being undertaken sooner than in a competitive market.

3.5. PRACTICAL RELEVANCE

32. The Commission considers three issues about the practical relevance of "asymmetric risk" for the implementation of TSLRIC:
- (i) The extent to which firms consider asymmetric risks in their decision-making;
 - (ii) The extent to which these risks are relevant to interconnection; and
 - (iii) The extent to which it is possible to actually estimate the implications of these asymmetric risks for the cost of capital.
33. We consider each of these issues below.

3.5.1. Firm Decision-making

34. One general way to address this point is to examine the observed behaviour of unregulated firms. Surveys from the US indicate that firms systematically employ investment hurdle rates far exceeding any potentially plausible conventional WACC estimate. This is consistent with the recognition of timing options and unsystematic risks.
35. It is frequently argued that high hurdle rates simply represent an internal control for over-optimistic cash flow projections. While this is largely a matter of conjecture, the only existing empirical evidence suggests otherwise. A survey of *Fortune 500* firms by Mukherjee and Hingorani (1999) finds that managers most frequently employ capital rationing (i.e., high hurdle rates) because of high unsystematic risk, project irreversibility, and valuable future investment opportunities. The first and third of these are consistent with concern about financing constraints; the second is consistent with the recognition of timing options. Internal control reasons are deemed to be less important than the above three factors.

3.5.2. Relevance to Interconnection

36. The Commission questions whether timing options are relevant to the determination of the TSLRIC for interconnection. In particular, it questions whether providing access services increases the need for investment in the access provider's fixed PSTN.
37. Our view is that the value of timing options derives from the fact that the economic life of an asset is uncertain in the presence of technical change and changes in patterns of demand. The provision of interconnection services requires the use of the fixed PSTN, and a share of the common cost of the fixed PSTN is a cost of interconnection. Since the fixed PSTN is subject to the threat of technical change and demand uncertainty, the value of timing options must be reflected in any calculations of the cost of the common, shared and service-specific costs of the network that are attributed to interconnection.

3.5.3. Calculation of the "Asymmetric Risks"

38. The Commerce Commission expresses concern about how the quantitative importance of these factors might be estimated. There are a number of possible approaches that may be used. For example:
 - Guthrie (2002) demonstrates a numerical approach to estimating the effects of truncated returns;
 - If timing options have not been eliminated by regulation, then their value can be estimated using the insights of McDonald and Siegel (1986); and

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- Unsystematic risks can be incorporated using the cash-flow-at-risk (a close relation of VaR) methodology suggested by Stulz (1999).
39. Overall, the difficulties associated with any of these approaches to the calculation of the impact of asymmetric risks on the rate of return are no greater than the problems associated with the calculation of the WACC itself. All empirical estimates in finance require assumptions and judgement. Calculations of the WACC are more familiar, which means that in practice the theoretical and empirical shortcomings of this approach are more readily ignored, but this should not be allowed to suggest that estimates of asymmetric risk are more difficult to derive or subject to larger errors of the estimate.

4. CONCLUSION

40. The standard approach to the calculation of the WACC should be regarded as a starting point for the consideration of the reasonable rate of return on capital invested. There is a substantial body of theoretical literature that supports the Commissions consideration of specific risk and the cost of options foregone, as well as empirical evidence that competitive firms take these factors into account in capital budgeting decisions. Neither the assumptions underlying calculations of the value of options and specific risk nor the practical difficulties of estimation are greater than those applying to standard calculations of the WACC.

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