Appendix F

Systematic Risk, Leverage and the Cost of Equity Capital

1 The systematic risk (β or beta) of a firm is the measure of how the changes in the returns to a company's stock are related to the changes in returns to the market as a whole. It is the only risk factor incorporated in the CAPM.

2 There are three basic approaches to estimating systematic risk:

- direct estimation;
- first principles; and
- comparable companies.

3 Ideally all three should be considered in the estimation and should reinforce each other. Before going through these three approaches, I will discuss the impact of leverage on financial risk.

Adjusting beta for the effect of leverage

4 A difficulty that arises with estimates of systematic risk is to properly reflect the leverage of the firm. Leverage gives a higher expected return to the equityholders, but at the cost of higher risk. The investor must decide if the trade-off between risk and return is acceptable with the borrowing.

5 To utilise equity beta estimates of comparable firms in developing my estimate of the equity beta for the ULLS-Network, the differences in leverage must be taken into consideration. This is done by converting an observed equity beta to what is called an asset beta by removing the effect of leverage. This process is referred to as de-levering. The result is an estimate of what the beta of the firm would be if it had no debt.

6 I will use the information on asset betas to estimate an asset beta for ULLS-Network, as part of the larger PSTN network. Then I will re-lever the asset beta using the leverage ratio for ULLS-Network to obtain an estimate of its equity beta.

7 The de-levering and re-levering calculations can be done a number of different ways. Each approach implies a different set of assumptions. An approach used by the ACCC is referred to as the Monkhouse formula.

$$\beta_e = \beta_a + (\beta_a - \beta_d) * \{1 - [R_d / (1 + R_d)] * (1 - \gamma) * T \} * (D/E) \qquad \textbf{(F1)}$$

where

β_e = equity beta,

β_a = asset beta,

β_d = debt beta,

R_d = cost of debt capital.

T = tax rate,

γ = value of imputation credits,

E = market value of equity,

D = market value of debt, and

V = market value of the firm (E+D).

8 Internationally, the standard formula that is used is:[1]

$$\beta_e = \beta_a * (1 + (1-T) * (D/E)) - \beta_d * (1-T) * (D/E)$$

9 This formula does not include consideration of the effect of dividend imputation, but has the advantage of extensive scrutiny and exposure on a worldwide basis. Also, this is the appropriate formula for any country that does not have dividend imputation. The UK has a form of partial dividend imputation, but it is not accepted practice there to recognise this in computations of WACC, CAPM or de-levering.

10 There is no absolute dominance of one of approach over another. Perhaps the most important consideration in performing the de-levering and re-levering of betas is to be consistent. Another consideration for purposes of this exercise is to limit the differences with the approach used by the ACCC. Therefore, I will use equation F1 for the de-levering of the comparable companies and then also for the subsequent re-levering to obtain an estimate of an appropriate equity beta for the provider of ULLS-Network. When using this equation with companies outside Australia, the value of dividend imputations is set at zero.

Debt beta

11 The technique of de-levering with equation F1 requires estimating the systematic risk of the debt of the company. This is referred to as the debt beta. There are a number of approaches to estimating the debt beta, but convention in Australia and among regulators has been to assume that it equals zero. I will make this assumption.

Direct estimation

12 The direct estimation method of assessing systematic risk can only be used for companies that are publicly listed on a stock exchange and whose stock is actively traded. Given sufficient historical data for the return on the shares of the company and returns on the market index for the stock exchange, the standard procedure is to calculate the returns on the stock and the market index and then to statistically determine the relationship between these two time-series of returns.

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[1] This formula was developed by T. Conine ("Corporate Debt and Corporate Taxes: An Extension," *The Journal of Finance*, September 1980, pp 1033-1037). It builds upon the work of R. Hamada ("The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks," *The Journal of Finance*, May 1972, pp 435-452) by not requiring that debt is riskless.

13 There is no absolute rule for how much data is required to reliably estimate beta. If the data is available, the most common method is to use five years of monthly returns. It is not unusual however to use as little as a year of data, using daily or weekly measurements of returns. In general, estimations using daily data will improve the statistical efficiency of the beta estimate if they are made over the same calendar period because of the substantially higher number of observations.

14 Two points must be kept in mind. First, what is required to calculate cost of equity capital is an estimate of the forward-looking systematic risk. However, this is not directly observable for any company. What can be calculated is the historic systematic risk. Then, if appropriate, this historic measure can be used as a proxy for the forward-looking measure. This approach is commonly used, provided there have not been substantive changes in the structure or circumstances of the company between the historic period and the expected future.

15 A factor that can make the use of historic estimates of beta of questionable validity is if there is a fundamental shift in the systematic risk of a company. This is a concern with telecommunications companies worldwide. In a recent report on the telecommunications services industry, Value Line[2] said the industry "is not timely". "Competition within the telecom sector is intense, and should remain so for many years." The experience of telecommunications companies worldwide is consistent with an increase in systematic risk over the recent past and going forward.

16 The second issue is that it is only possible to observe returns to equity of the listed company, in this case Telstra. It is not possible to observe returns to the equity of ULLS-Network. Observations of beta for Telstra may be useful, but cannot be directly used as the beta for ULLS-Network.

17 I calculate the equity beta of Telstra using the S&P ASX-200 index as the market index. Although Telstra has been a publicly listed company since 1997, I will use data for the past five years. This is the most common practice for estimating equity betas. It also avoids including the share price effects of Telstra's two share issues (i.e., T1 in October 1997 and T2 in November 1999) in the data used to estimate beta.

18 Key descriptive statistics with respect to the daily returns for Telstra's shares and for the market index for the period from 1 November 2000 through 31 October 2005 are shown below.

	Telstra Shares	S&P ASX-200
Average daily return	-0.02%	0.03%
Minimum	-9.39%	-4.69%
Maximum	6.12%	3.50%
Standard deviation	1.23%	0.66%

2 "The Value Line Investment Survey, Part 3, Ratings and Reports," July 1, 2005, p 719.

19 The data clearly shows that Telstra has been more volatile than the market index over the past five years. In earlier reports I have shown that this has been the case since Telstra first became publicly listed. The standard deviation of returns for Telstra is nearly double that of the S&P ASX-200 and the minimums and maximums are similarly more extreme for Telstra shares.

20 Volatility of equity returns is a measure of risk, but not directly systematic risk as is used in the CAPM. However, empirically there is a positive correlation between total risk (such as standard deviation of returns) and systematic risk. This data is consistent with an equity beta for Telstra well above one.

21 Having decided to use the five years of data from 1 November 2000 to 31 October 2005 in my estimation of Telstra's equity beta, I have to decide upon the interval I will use in measuring returns. The alternatives are daily or weekly or monthly. In general, daily provides more observations but weekly or monthly smooth out more random variation and therefore usually have more explanatory power. The choice is a matter of judgement. The equity beta results are shown below. The R^2 is a statistic that measures the goodness of the fit of the estimate.

	Daily	Weekly	Monthly
Equity beta	0.773	0.550	0.060
R^2	0.173	0.097	0.002

22 The results above are not consistent across the measurement intervals. The result based on daily data is roughly what would be expected for Telstra. However, the sharp decrease in both the equity beta and the R^2 with the longer measurement intervals is unusual. The result with monthly intervals is meaningless.

23 The R^2 of 0.002 indicates no relationship between Telstra and the market index. The lower the R^2, the less of the fluctuations in the returns to a company's stock is related to movements in the returns to the whole market. Put another way, it indicates that the CAPM explains very little about the returns to a company. It is a statistical property that as the R^2 approaches zero, the estimated beta is forced to zero. Therefore, beta estimates with very low R^2 will also tend to have low betas.

24 The AGSM Risk Measurement Service provides beta estimates for companies listed in Australia, including for Telstra, based upon 48 months of data. The issue of June 2005 reports an equity beta for Telstra of 0.38 with an R^2 of 0.05.

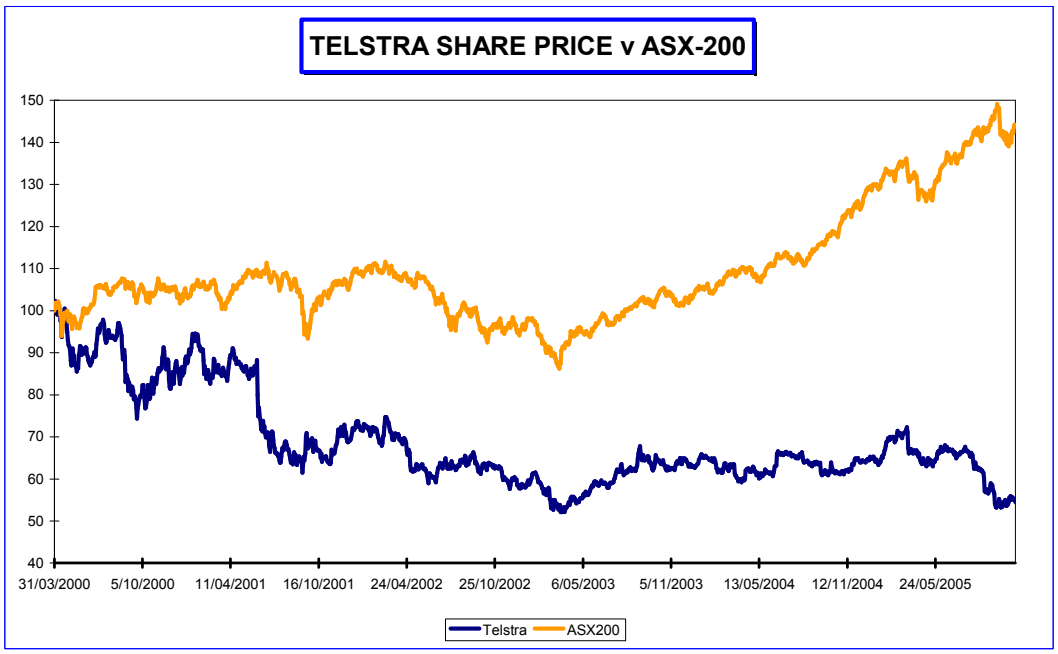
25 The service also reports the Scholes-Williams beta estimate as 0.96 at June 2005. The Scholes-Williams approach to estimating beta is intended to control the effect of thin trading where the measurements of the return to the shares and the return to the market index are not contemporaneous. The estimation approach is normally useful for shares that are infrequently traded. This is clearly not the case with Telstra as its shares are among the most actively traded on the Australian Stock Exchange ("**ASX**"). However, the estimation approach also captures leads and lags between the share price and the market index.

26 The AGSM provides a LM test statistic, which indicates when the Scholes-Williams approach may be appropriate. "When this LM statistic is small (say less than 0.050), then there is evidence of the types of biases in the OLS estimate that

the Scholes-Williams technique is designed to handle. In these situations, the Scholes-Williams estimates are likely to be more reliable than the OLS estimates."[3] For Telstra, the LM statistic is 0.011, clearly indicating that the Scholes-Williams beta estimate is preferred to the OLS estimate.

27 The research by Scholes and Williams[4] that developed the estimation procedure also documents that the standard Ordinary Least Squares ("**OLS**") estimation of beta will tend to be biased downward for stocks that are either low or high volume. This is consistent with the beta estimate for Telstra being an under estimate of the true beta.

28 The range of beta estimates for Telstra reported above require interpretation and an assessment of how the historical data should be used to estimate a forward-looking equity beta. To assist this assessment, the share price performance of Telstra and the S&P ASX-200 market index are shown in the graph below. The two time-series are indexed to be equal to 100 at the beginning of the period.



29 Over the period of about five years, the S&P ASX-200 increased by over 40% while Telstra shares declined by over 40%. It is not particularly surprising that the standard Ordinary Least Squares technique for estimating beta from this historical data does not produce clear and consistent results.

30 As with all the process of estimating betas, how to use the data presented above is a matter of judgement. My first conclusion is that the beta estimates from recent historical data are of limited value.

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3 Australian Graduate School of Management, Centre for Research in Finance, "Risk Measurement Service Introduction," p 11.

4 M. Scholes and J. Williams, "Estimating Betas from Nonsynchronous Data," *Journal of Financial Economics* 5, 1977, pp 309-327.

31 Based on the information and considering the precision of the estimates, I believe the most credence should be given to the results with daily measurement intervals, supported by the Scholes-Williams results from the AGSM Risk Measurement Service. However, the results also indicate the estimation error using historical data will be quite large.

32 From the results reported above, I estimate that the best point estimate of the historic equity beta of Telstra is 0.8. However, the results do not instil confidence in this approach as a reliable estimator of a forward-looking beta.

First principles

33 The second approach to estimating the systematic risk of the ULLS-Network is to work from first principles. This approach requires thinking about the factors that impact on the sensitivity of a firm's returns to movements in the economy/market. One way to analyse this is to refer to the Arbitrage Pricing Theory research, particularly the seminal empirical study by Chen, Roll and Ross.[5] They find that the factors that explain stock market returns are unexpected changes in real GNP, inflation, market risk aversion and long-term real interest rates. The latter three will usually have a similar impact on the systematic risk of firms, so the first factor is the most useful to analyse. The following firm characteristics should provide indications of a firm's sensitivity to unexpected changes in real GNP.[6]

- operating leverage;
- income elasticity;
- terms of contractual arrangements; and
- nature of regulatory regime.

Operating leverage

34 [c-i-c]

Income elasticity

35 The income elasticity of ULLS-Network measures how changes in user income affect the demand for those services. Since changes in the income of users will be related to changes in the economy, there should be a positive relationship with systematic risk.

36 Estimates of income elasticity for the short run (and small changes in income) vary considerably but are positive and less than one. For example,[7] Gassner estimates

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5 N. Chen, R. Roll and S. Ross, "Economic Forces and the Stock Market," *Journal of Business*, 1986, pp 383-403.

6 The implications of financial leverage have been addressed separately.

7 The references for the studies cited in this section are as follows: M. Aldebert, M. Ivaldi and C. Roucolle, "Telecommunication Demand and Pricing Structure: An Economic Analysis," Proceedings of the 7th International Conference on Telecommunications Systems, 1999; D. Cracknell, "Growing the Telecommunications Market – Lessons from the Past," Proceedings of the International Telecommunications Society, Regional Meeting, Crete, 1994; A. Dobell, L. Taylor, L. Waverman, T. Liu

income elasticity to be 0.14, Kuriyama, Oniki, Ota and Ohmura find 0.54, Cracknell gives an elasticity of 0.69, which is close to Aldebert, Ivaldi and Roucolle's estimate of 0.66.

37 On the other extreme of the range of estimates, the three equations of Dobell, Taylor, Waverman, Liu and Copeland all have values in excess of 1.5 in the long run (2.38, 2.16 and 1.55 depending on the specification of the econometric model). Similarly, Waverman's long-run estimate is 1.25.

38 In his survey of the empirical literature on the income elasticities of demand for selected telephone services at the retail level, Taylor provides point and interval estimates of long run, steady-state elasticities based on various empirical studies:

Type of Demand	Income elasticity
Access	0.5 (±0.10)
Local Calls	1.0 (±0.40)
Toll calls - intrastate	1.25 (±0.25)
Toll calls - interstate	1.50 (±0.40)
Toll calls - international	1.70 (±0.40)

39 ULLS-Network service is provided at the wholesale level to access seekers who provide retail services. Hence, the income elasticity of ULLS-Network services is derived from the retail elasticity faced by the access seekers. The income elasticity at the wholesale level is likely to be as high as the income elasticity at the retail level. Further, the income elasticity of access faced by the access provider will be the same as the elasticity for the end product of the access, i.e., the calls. This indicates that the long run, steady-state income elasticity of ULLS-Network is greater than one. It also indicates that the short run income elasticity for ULLS-Network will be greater than indicated by the research on short run elasticity cited above.

40 The income elasticity that is relevant to an agreement and WACC is for one year. From all of the literature, I conclude that the income elasticity of ULLS-Network is approximately one.

Terms of contractual arrangements

41 [c-i-c]

Nature of regulatory regime

42 The regulatory regime for ULLS-Network is set out in *inter alia*, the Trade Practices Act 1974, Telecommunications Access Regime, Part XIC ("TPA").

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and M. Copeland, "Telephone Communications in Canada: Demand, Production, and Investment Decisions," *The RAND Journal of Economics*, 1972, pp 175-219; K. Gassner, "An Estimation of UK Telephone Access Demand Using Pseudo-Panel Data," *Utilities Policy*, 1998, pp 143-154; T. Kuriyama, H. Oniki, K. Ota and S. Ohmura, "Analysis of Family Facsimile Demand," *IPTP Discussion Papers,* no. 1994-12, 1994; L. Taylor, *Telecommunications Demand in Theory and Practice*, 1994 (Kluwer Academic Publishers, Boston); L. Waverman, "Demand for Telephone Services in Great Britain, Canada and Sweden," International Conference on Telecommunications Economy, 1974.

Section 152AR of the TPA describes the relationship between the access provider and the access seeker. The legislation seeks to facilitate the parties' efforts to reach a commercial agreement without the involvement of a regulator. I expect that it is likely that a commercial agreement between the parties would reflect the economic conditions prevailing in the economy. This is implied in describing the agreement as commercial. I also believe that economic conditions would affect the probability of reaching an agreement. I expect that the probability of reaching an agreement would be higher when economic conditions are stable. The more economic conditions are changing, the more likely that the perceptions and incentives of the access provider and the access seeker will diverge.

43 I believe that the outcome of the regulatory process in the event of failure to reach agreement should also reflect conditions in the economy, and that this is consistent with a moderate asset beta.

Conclusion

44 The review above of factors which impact on the sensitivity of ULLS-Network services to unexpected changes in GNP, and hence to changes in the market, indicates that there are conflicting pressures. However, on balance I believe the factors are consistent with a moderate asset beta, but less than one. In addition, I do not see any clear indication that the factors are likely to change for the three years going forward.

45 Considering all of the factors discussed in this section on first principles, I believe they indicate an asset beta for ULLS-Network in the range of 0.4 to 0.9. The range indicates the lack of any precise guidance from consideration of the first principles approach to estimating systematic risk in this case.

Comparable companies

46 Comparable company analysis is a commonly used approach to estimating beta. A set of comparable (listed) firms is first identified. Using share price information for the companies, their equity betas are estimated. When the equity betas of the comparable firms are estimated, they will all have different leverages. Then additional information about the companies, in particular their leverage, is used to de-lever the equity betas. The objective of the process is to convert the measure of systematic risk of the equity to a measure of the systematic risk of the firm as if it was an all equity firm that had no debt. The effect of the actual leverage of the firm is extracted from the equity beta, and the result is referred to as the asset beta.

47 If the businesses of the firms used are truly comparable, then the asset betas, which are free of the influence of leverage, should be comparable. The average asset beta of those firms is used as a consideration in the estimation of the asset beta of ULLS-Network.

48 The difficulty with this approach is identifying a satisfactory set of comparable companies. There are advantages to having a large number of companies so that individual peculiarities or measurement errors are averaged out. However, the more the sample is enlarged, the less the companies included are comparable to ULLS-Network. The best balance in this trade-off is a matter of judgement.

49 Although there are other companies in the telecommunications industry in Australia, I do not regard any of them as useful proxies for an operator of ULLS-Network. There are also many telecommunications companies around the world that are publicly traded but only a few that are primarily telephone networks. The main comparable companies are the four remaining Regional Bell Operating Companies ("**RBOCs**") in the US. I also include five telecommunications companies that are major providers of communications services and have some similarities to ULLS-Network: AT&T, BT Group, Deutsche Telekom AG, Telecom de Mexico and Telecom New Zealand.

50 I collected equity beta and financial statement information for each company from Value Line and Yahoo Finance. Using this data, including the beta estimates from Value Line, I computed each firm's asset beta. The results for the nine companies are shown in table F1 below.

Table F1: Asset Betas of Comparable Companies

Company	Country	Asset Beta
BellSouth Corp	US	0.81
Qwest Communications	US	0.75
SBC Communications	US	0.87
Verizon Communications	US	0.76
Average of RBOCs		0.80
AT&T	US	0.97
British Telecom	UK	0.71
Deutsche Telekom AG	Germany	0.76
Telecom de Mexico	Mexico	0.71
Telecom NZ	NZ	0.54
Average of other Telecoms		0.90
Average of all Telecoms		0.85

51 The average asset beta for the four companies that are the most comparable with an operator of ULLS-Network is 0.80. The average asset beta of the other five telecommunication services companies is 0.90. When all nine companies are included the average asset beta is 0.85.

52 In evaluating this information, there is another factor to consider. The companies are involved in activities in addition to those that are similar to ULLS-Network.

53 The comparable companies are involved in a range of activities in addition to those that are comparable to ULLS-Network. In general these other businesses are in emerging and less mature areas that will have higher risk. As a result, the beta for ULLS-Network is likely to be somewhat lower than the average of the comparable companies.

54 Based on the data above, I believe a best estimate of asset beta for ULLS-Network based upon the comparable company data is 0.8.

55 The asset betas of the nine comparable companies above are relatively tightly clustered. However, this is not an adequate basis for estimating a range on asset beta. Each of the asset betas is estimated with substantial estimation error. This issue and the estimation of a range are discussed in more detail in my main report.

Asset beta evidence and conversion to an equity beta

56 The information on an asset beta for ULLS-Network can be summarised as follows. Estimates of the beta of Telstra support an equity beta of 0.8 for ULLS-Network. This transforms to an asset beta of 0.74. The range on this should be at least ±0.3. First principles evidence indicated a possible range for an asset beta of 0.4 to 0.9. Comparable companies evidence supports an asset beta estimate of 0.8.

57 In my opinion, the information from the three sources is consistent and supports an asset beta estimate for ULLS-Network of at least 0.7. The data also supports a one standard deviation range of at least ±0.3.

58 The next step is to convert the asset beta to an equity beta by way of a formula that imputes the gearing estimated for ULLS-Network. I use equation F1 for this purpose. In my opinion, an appropriate point estimate for all three periods of the forward-looking equity beta for ULLS-Network is 0.873.