Regression-based estimates of risk parameters for the benchmark firm

24 June 2013

PO Box 29, Stanley Street Plaza
South Bank QLD 4101
Telephone +61 7 3844 0684
Email s.gray@sfgconsulting.com.au
Internet www.sfgconsulting.com.au

SFG CONSULTING

Level 1, South Bank House
Stanley Street Plaza
South Bank QLD 4101
AUSTRALIA

Contents

1. Preparation of this report

This report was prepared by Professor Stephen Gray and Dr Jason Hall. Professor Gray and Dr Hall acknowledge that they have read, understood and complied with the Federal Court of Australia's Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia. Professor Gray and Dr Hall provide advice on cost of capital issues for a number of entities but have no current or future potential conflicts.

2. Executive summary

SFG Consulting has been engaged by the Energy Networks Association to provide expert opinion on inputs into three asset pricing models used to estimate its cost of equity – the Black and Sharpe-Lintner Capital Asset Pricing Models (CAPMs) and the Fama-French three factor model (Fama-French model).[1] In this report we present estimates of risk which have been derived only from the analysis of historical stock returns. We do not discuss the reliability of regression-based analysis of historical returns for estimating exposure to risk factors and we do not comment upon the relative merits of either model for estimating the cost of equity capital. This is because we are instructed that those other matters are being addressed in other reports that have been commissioned by the ENA.[2]

With respect to the CAPMs we have compiled estimates of systematic risk, also termed market or economic risk, which is a measure of the risk associated with overall market movements. Systematic risk is commonly referred to as beta and the average investment in the market has a beta of one.

With respect to the Fama-French model, we have estimated systematic risk, along with exposure to the size and book-to-market factors. The size factor represents the difference in expected returns to a portfolio of small market capitalisation stocks and a portfolio of large market capitalisation stocks, or *SMB* for "small minus big." [3] The book-to-market factor represents the difference in expected returns to a portfolio of high book-to-market stocks and a portfolio of low book-to-market stocks, or *HML* for "high minus low." [4] This is also commonly referred to as the difference in expected returns to value and growth stocks.

We perform separate analysis on nine Australian-listed stocks and 56 U.S.-listed stocks for the reasons explained in the body of the report, using returns information over an 11 year period from 2002 to 2012. The sample of Australian-listed firms is the same sample adopted by the Australian Energy Regulator in its 2009 review of weighted average cost of capital parameters (AER, 2009; Henry, 2009). The sample of U.S.-listed firms has been selected by Competition Economists Group (CEG, 2013).

Our estimates are formed in two ways, as an equal-weighted average of individual firm estimates and derived from equal-weighted returns indices. The advantage of analysing individual firms is that the dispersion of coefficient estimates across firms provides an indication of the imprecision of our estimation techniques and sample selection. The greater the dispersion of the estimates across firms the more it calls into question the reliability of the estimation techniques when applied to a set of firms otherwise considered comparable. However, not all firms are available for analysis over all time periods, so an index of firm returns allows us to construct one time series in each market that is available over the entire 11 year period.

Our analysis relies upon all available information during this period. Our estimates are based upon four-weekly returns. But we use all daily stock prices in our analysis by repeating the analysis 20 times using different start points to compute four-weekly returns.[5] Our estimates also incorporate a leverage adjustment, commonly referred to as "re-levering," so that they are estimates of risk if firms adopted leverage of 60%. We adopt the same re-levering process as the AER (2009).

[1] See Sharpe (1964), Lintner (1965), Black (1972) and Fama and French (1993).

[2] See NERA (2013), Review of cost of equity models, June.

[3] Size is measures as the market capitalisation of the firm's equity (essentially the number of shares multiplied by the share price). It is common to define the top third of stocks to be "big" and the bottom third to be "small."

[4] Book to market is the ratio of the book value of equity to the market value of equity. It is common to define the top third of stocks to be "high" and the bottom third to be "low."

[5] An exception to this approach is the application of the Fama-French model to Australian-listed stocks, for which we only have only been provided with monthly return factors. The monthly return factors were compiled by NERA.

With respect to the Fama-French factors, to illustrate the impact of alternative coefficient estimates on the cost of capital we have incorporated *SMB* and *HML* risk premiums proposed by NERA (2013). For the analysis of Australian firms these estimates are 3.05% for *SMB* and 7.68% for *HML*. For the analysis of U.S.-listed firms these estimates are 3.58% for *SMB* and 4.81% for *HML*. The measurement of *SMB* and *HML* across the two markets will be dependent upon the characteristics of large versus small firms in both market, and high versus low book-to-market firms in both markets. So it is not appropriate to compare the coefficients s and h across the two markets. We can only compare $s \times SMB$ and $h \times HML$ across the two markets.

With respect to the CAPM, and relying purely on historical returns to estimate beta, we have the following results.[6]

- An estimate from nine Australian-listed firms within the range of 0.4 to 0.8.[7]
- An estimate from 56 U.S.-listed firms within the range of 0.8 to 1.0.[8]
- An estimate from a pooled sample of 65 Australian and United States-listed firms of 0.7 to 1.0.[9]

With respect to the Fama-French model, and relying purely on historical returns to estimate coefficients, we have the following results[10]

- For nine Australian-listed firms, an estimate for beta of 0.3 to 0.9, and an estimate for the size and book-to-market premiums ($s \times SMB$ and $h \times HML$) of 1.1% to 6.3%.
- For 56 U.S.-listed firms, an estimate for beta of 0.8 to 1.0, and an estimate for the size and book-to-market premiums ($s \times SMB$ and $h \times HML$) of –1.3% to 1.9%.
- For a pooled sample of 65 Australian- and U.S.-listed firms, an estimate for beta of 0.7 to 1.0, and an estimate for the size and book-to-market premiums ($s \times SMB$ and $h \times HML$) –0.9% to 2.2%.

When comparing estimates of the total return on equity for the benchmark firm across the two markets, we note that:

1. The estimates of the risk premium for market risk are lower for the Australian market than for the US market (i.e., a lower beta estimate for the Australian sample);
2. The estimates of the risk premium for the HML factor are higher for the Australian market than for the US market; and
3. The estimates of the risk premium for the SMB factor are economically small for both markets.

The net result is that the estimates of the total required return on equity are similar for both markets – the lower Australian estimate of the premium for market risk is offset by the higher premium in relation to the HML factor. Both samples generate similar estimates of the required return on equity.

---

[6] These are re-levered beta estimates assuming gearing of 60%. The ranges are the upper and lower bounds of 95% confidence intervals constructed separately for the individual firm and index analyses.

[7] In the body of this report we note that this estimate is based on a very small sample (there are only five live data points as four of the nine Australian firms in the Australian sample are now delisted) and the conclusion from Brooks, Diamond, Gray and Hall (2013c) is that such an estimate is statistically unreliable.

[8] Brooks, Diamond, Gray and Hall (2013c) show that estimates from such a large sample are statistically reliable.

[9] The US data mist be used is any sort of statistically reliable estimate is to be obtained.

[10] These confidence intervals do not account for imprecision in the estimation of *SMB* and *HML*. They only account for imprecision in the estimation of β, s and h. They are presented so we can compare ranges for risk premiums across the two markets.

Our view is that it is important to interpret all of this evidence holistically. As set out above, the Australian sample is too small to produce reliable estimates – there being only five live data points, compared to the US sample of 56. In our view, it would be wrong to give no weight to the large and statistically reliable US data sample and to give 100% weight to the handful of Australian data points. The Australian estimates of the relevant coefficients are statistically unreliable as they are based on such a small sample. However, even if one were to rely exclusively on the Australian estimates, the over-estimation of one risk premium and the under-estimation of another (relative to the large-sample US values) offset one another resulting in a similar estimate of the total required return on equity for the benchmark firm.

Our preferred approach is to use *all* of the relevant data, weighted appropriately to reflect the comparability of the data and the statistical reliability of the estimates. That is, the estimates set out above need to be distilled into final parameter estimates for the CAPM and the Fama-French model, which raises the question as to how much weight should be placed on the evidence from Australian-listed firms and the U.S.-listed firms. In reaching a conclusion we considered the issues of relevance and reliability. Ideally we would have a large number of Australian-listed firms to analyse. But the reality is that this sample is so small that to rely upon it in isolation leads to estimates which are unreliable, an issue which is addressed in Brooks, Diamond, Gray and Hall (2013c). The set of comparable firms from the United States was scrutinised by CEG (2013) with respect to the proportion of assets under regulation, their industry classification and their prior use in comparable firm analysis for regulatory decision-making.

So in reaching our final parameter estimates we allowed for each observation of an Australian-listed firm to count for twice as much weight as a U.S.-listed firm. This means that the weight placed on the evidence from the Australian-listed firms is 24% [that is, $9 \times 2 \div (9 \times 2 + 56) = 0.24$] and the weight placed on the estimates from the U.S.-listed firms is 76%. Placing twice as much weight on an Australian observation compared to a U.S. observation implies the following parameter estimates:[11]

- For the CAPM, a beta estimate of 0.82.
- For the Fama-French model, an estimate for beta of 0.79, an estimate for $s \times SMB$ of –0.17% and an estimate for $h \times HML$ of 1.23%.

[11] See the last row of Table 4

3. Methodology

3.1 Introduction

A common technique for estimating systematic risk (beta) is to perform an ordinary least squares (OLS) regression of stock returns on market returns. The slope of the regression line is the beta estimate. However, there is evidence that OLS beta estimates are subject to a high degree of imprecision and limited ability to predict stock returns when incorporated into an expected returns equation (Gray, Hall, Klease and McCrystal, 2009). To minimise estimation error we adopt the estimation techniques described in this section.

One easily-implemented technique to mitigate estimation error is to incorporate the Vasicek adjustment (Vasicek, 1973).[12] Vasicek demonstrated that, without adjustment, low beta estimates are likely to understate systematic risk and high beta estimates are likely to overstate systematic risk.[13] Similar adjustments to the Vasicek adjustment are adopted by Bloomberg and Datastream,[14] but have not been accepted by the AER (2009).

In a related piece of work, we empirically tested our estimation technique on a sample of 2,585 Australian-listed firms (Brooks, Diamond, Gray and Hall, 2013a). In this analysis we tested whether CAPM beta estimates formed in the manner described below, could be used to explain subsequent realised stock returns after the beta estimates were formed. For each stock we compiled expected returns, based upon beta estimates from historical returns information, and excess market returns in the next month. We then compared the ability of these expected returns to explain realised stock returns, compared to a base-case assumption that the expected return for all stocks is equal to the market return.[15] We found that beta estimates compiled using the Vasicek adjustment had more explanatory power than OLS estimates.

OLS is the standard regression technique for estimating betas from historic stock returns. The AER has also given consideration to least absolute deviation (LAD) estimates. We analysed LAD estimates and found that they exhibit a downwards bias (Brooks, Diamond, Gray and Hall, 2013b). This bias is material and is approximately 0.15 for the average firm. So if implemented into regression-based estimates of risk this is likely to result in cost of capital estimates with a material downwards bias.

3.2 Details

First, we use all available daily share price information for analysis over our estimation period. We compute total returns over a four-weekly period for each stock, but repeat our analysis 20 times using different start points within this four-weekly period. This provides the benefit of using a returns window of approximately one month, but also means that we do not ignore any stock and market returns information. The beta estimates for each firm can vary markedly, depending upon the start point during the month that returns are calculated. In other words, the beta estimate for a given firm will be quite different depending upon whether the returns are estimated from the first Monday of the month or the third Wednesday of the month. For example, with respect to our sample of 56 United

[12] The mechanics of the Vasicek approach, the statistical motivation for using it, and the relative performance of Vasicek estimates are detailed in our companion report Brooks, Diamond, Gray and Hall (2013a). Essentially, the Vasicek approach begins with the average beta of all firms (1.0) and only moves away from this default value to the extent that is statistically justified.

[13] Blume (1975) documented mean-reversion tendencies of OLS beta estimates but Vasicek (1973) was able to demonstrate that this occurs purely because of the statistical properties of the estimates, even if the actual systematic risk of the firm is unchanged.

[14] See Cunningham (1973) for the justification for the technique used by Datastream. The rationale of Cunningham matches that of Vasicek (1973).

[15] That is, the performance of different estimation methods was compared against the performance of a base-case (or default) estimate that the best beta estimate for all stocks is simply to use the average beta value of 1.0.

States-listed firms, the average difference between the high and low raw OLS beta estimates for each firm, across the 20 estimates, was 0.32. In other words, a typical firm could have a beta estimate within a range of 0.32 based entirely upon the start day for computation of returns. As another metric for imprecision associated with the random start day, across the sample of 56 firms the average raw OLS estimate would have fallen anywhere between 0.57 and 0.77, depending upon the random start point for returns computations.

An exception to this practice is the analysis of the Fama-French model for Australian-listed stocks. In this instance we only have monthly return factors available to us, so this analysis is performed using returns over calendar months, rather than 20 times using four-weekly returns. More details on the factors is contained in Section 4.

Our time period for estimation begins on 2 January 2002, consistent with the start date used by the AER (2009), and ends on 19 November 2012 for United States listed firms and 19 February 2013 for Australian-listed firms. The end dates merely coincide with the date at which the analysis was conducted, not because there was an event which implied that the United States data became irrelevant. Hence, we use 11 years of data in performing our analysis. This is longer than the four or five year period typically adopted by data providers such as Bloomberg or Datastream in their default estimates. A firm's systematic risk may change over time, so intuitively, analysis of stock and market returns over a more recent time period provides a more reliable estimate of risk. But the volatility of stock returns is very large, so the noise associated with using short time periods for estimation is also very large.

Second, we incorporate an adjustment to the OLS estimates to account for the tendency for low beta estimates to understate true systematic risk and high beta estimates to overstate true systematic risk.[16] The adjustment is based upon the standard error of the estimate and is referred to as the Vasicek adjustment. Estimates further from one and with a larger standard error are adjusted more than estimates close to one with a low standard error. A similar adjustment is incorporated into the default estimates of beta reported by Datastream, and Bloomberg reports beta estimates using a constant adjustment, placing two-thirds weight on the OLS estimate and one-thirds weight on a prior estimate of one.

Despite the importance of this technique, because we use a long time series of data the adjustment does not have a large impact on the mean beta estimate. Specifically, in our sample of 56 U.S.-listed firms the average difference between the raw OLS estimate and the Vasicek-adjusted OLS estimate is 0.01. For the nine Australian firms this average difference is 0.03. The important point is that we use this technique because we have empirical evidence from a large sample that it generates beta estimates that have less dispersion across firms, are more stable over time and have more ability to predict future stock returns than OLS estimates. But when applied to the particular firms in our dataset the adjustment is small because we use a long time series for estimation. In another sample of beta estimates with higher standard errors, the adjustment will be more important.

In implementing the Fama-French model there is no Vasicek-type adjustment. This is because the construction of *SMB* and *HML* factors is a function of two particular stock characteristics, market capitalisation and the book-to-market ratio. *SMB* is the difference in returns on a portfolio of large stocks and a portfolio of small stocks. *HML* is the difference in returns on a portfolio of high book-to-market stocks minus the difference in returns on a portfolio of low book-to-market stocks. So a small stock will form part of the long portion of the *SMB* portfolio, and a large stock will form part of the

[16] The statistical basis for this effect is explained in our companion report, Brooks, Diamond, Gray and Hall (2013a). Even if estimation error (i.e., noise in the estimation process) is symmetric so that an individual estimate is equally likely to be over- or under-estimated, estimates of beta that are below 1.0 are more likely to have been contaminated by negative estimation error and vice versa for estimates of beta above 1.0. The further an estimate is away from 1.0, the more likely it I to have been more affected by estimation error.

short portion of the *SMB* portfolio. Further, a high book-to-market stock will form part of the long position in the *HML* portfolio and a low book-to-market stock will form part of the short position in the *HML* portfolio.

So, on average, we would expect a small stock to have positive exposure to the *SMB* portfolio returns and a large stock to have negative exposure to the *SMB* portfolio returns. The same idea holds for high and low book-to-market stocks with reference to the *HML* portfolio. This will not be the case for every individual stock. We can observe a large stock having a negative coefficient on the *SMB* factor and a small stock having a positive coefficient on the *SMB* factor.[17] But it will be the case on average. However, we don't know what this expected exposure is for the small stock, or the large stock, or the high book-to-market stock or the low book-to-market stock. This means that we don't have a basis for estimating what the exposure of the stocks is to *SMB* and *HML* factors. In implementing the Fama-French model we make no Vasicek-type adjustment to the beta coefficient either, because we do not know whether implementing the other two returns factors has already mitigated the tendency for low beta stocks to understate risk and for high beta stocks to overstate risk.

Third, we account for differences in leverage between our sample firms and the 60% benchmark leverage. In analysis of systematic risk, there is often discussion of asset beta and equity betas. The asset beta is an estimate of the systematic risk of equity in the absence of financial leverage. The estimated equity beta is "un-levered" to strip out the impacts on leverage. Then there is often a revised estimate of the equity beta on the basis of an alternative capital structure. This is often the case for equity beta estimates set by regulators, in which the assumed capital structure of the regulated business is different to the capital structure of the firms used in estimation.

3.3 Interpretation

The estimates in this report are the most reliable estimates for the CAPM and Fama-French models that we can obtain using analysis only of historical stock returns over the past 11 years. But this does not mean that the risk premiums implied by these estimates are precise. There is no guarantee that CAPM or Fama-French models capture all of the risks involved in pricing assets, there is no guarantee that the sample of firms is a perfect proxy for the risks faced by the benchmark NSP and there is no guarantee that the sample of returns available to us is representative of the population of returns which could have been observed over the last 11 years. Furthermore, these estimates do not account for information other than historical stock returns, leaving open the possibility that other firm characteristics could be used to generate more reliable parameter estimates. That is, the estimates set out in this report represent the best that can be done with the available models and the available data. The fact that the models are subject to misspecification error and the data are a source of estimation error should be carefully considered when determining the weight to be applied to this evidence.

There is substantial dispersion in the coefficient estimates for firms in the Australian sample and for firms in the United States sample, leading to wide confidence intervals. This could occur because the individual firms in the sample really do have different amounts of systematic risk, and so are not really comparable. Or the dispersion in estimates across firms could occur because the firms in the sample have similar degrees of systematic risk, but stock returns are so noisy[18] that the measurement of risk using this data is highly imprecise.

[17] This is because the Fama-French model is not based on the firm characteristic of size, but rather on the firm's sensitivity to the SMB factor. That is, firms require a higher return not because they are small per se, but because their returns covary with the SMB factor. In the data, smaller firms tend to have returns that covary with the SMB factor, on average, but such covariance does not exist for every small firm.

[18] That is, stock returns are subject to random, firm-specific variation in addition to the effects of any systematic risk exposures.

We present results for nine Australian-listed firms (only five of which are currently listed), 56 United-States-listed firms, and a pooled sample of 65 firms across the two markets. In summarising the results we draw a conclusion by giving each Australian observation twice as much weight as a U.S. observation. This represents a trade-off between comparability and reliability of a small sample of Australian-listed firms and a large sample of U.S.-listed firms. In our companion report, Brooks, Diamond, Gray and Hall (2013c), we show that estimates based only on the small handful of Australian firms are inherently unreliable. The current sample of five Australian data points is simply insufficient to generate reliable estimates – such a small sample produces estimates that have wide confidence intervals and which vary wildly and unreasonably over short periods of time. Brooks, Diamond, Gray and Hall (2013c) also show that increasing the sample size to more than 20 or 30 data points materially improves the quality and reliability of estimates. Thus, there is a trade-off between comparability (given that the benchmark NSP is an Australian network) and reliability (given that the Australian data alone is insufficient to produce reliable estimates). In our view, it is clear that the US data must be included to obtain any sort of statistical reliability. However, we have applied judgment to give each Australian data point more weight than each US data point in two ways: (a) we include estimates from four Australian firms that are now delisted, and (b) we give each Australian firm twice the weight of each US firm.

4. Data

4.1 Selection

4.1.1 Sample size and reliability

The reason we use both Australian- and U.S.-listed firms is because there are so few Australian-listed network businesses that to use only this sample runs the risk of substantial estimation error. In related work (Brooks, Diamond, Gray and Hall, 2013c) we document the variation in average beta estimates we would expect to observe across samples of different size. We estimate that increasing sample size from nine to 18 firms is likely to reduce the dispersion of risk estimates by about one-third, and increasing sample size further to 27 firms is likely to reduce this estimation error by half. We reach this conclusion by randomly sampling risk estimates from Australian-listed stocks in the same industry groups, and measuring how much average risk estimates vary across samples of different size. We also document the substantial variation in average risk estimates from one time period to the next, even when the sample remains constant.

The conclusion is that, if a sample of just nine firms is used to estimate risk, there is likely to be a difference of several percentage points in cost of capital estimates depending upon which nine firms are available for analysis. And there will also be a difference of several percentage points in cost of capital estimates depending upon the time period selected. That is, if no reliance is placed on the United States-listed firms that are available for analysis, the results will be highly unreliable. CEG (2013) has concluded that the level of risk for the set of U.S.-listed firms is similar to that of the benchmark firm.

4.1.2 Australian-listed firms

We analysed returns on nine Australian-listed energy network companies over an 11 year period from 2 January 2002 to 19 February 2013. The Australian firm sample corresponds to the sample analysed by Henry (2009). On average these stocks have market capitalisation of $2.1 billion and have 91 four-weekly returns in each regression (about seven years of returns[19]. The Australian market index is the All Ordinaries Accumulation Index. Corresponding information for each sample firm is presented in the Appendix. Only five of the Australian-listed firms comprise the dataset at the end of the sample period (SP Ausnet, Duet Group, Envestra, Spark Infrastructure and APA Group). Gasnet, Alinta and HDF are no longer traded, and we do not consider the returns of AGL post 10 October 2006 because from that time onward it divested its infrastructure assets and ceased to be a suitable comparator.

The *SMB* and *HML* factor returns for Australia were provided by NERA on a monthly basis. For *HML,* NERA used estimates for Australia obtained from Ken French's website.[20] For *SMB,* NERA constructed the returns factors by analysing the 500 largest stocks by market capitalisation each month, and partitioning those stocks into the smallest 30%, middle 40% and largest 30%. *SMB* is then the value-weighted return on the portfolio of small stocks minus the value-weighted return on the portfolio of large stocks. The construction of the Australian-based risk factors follows the procedure outlined in Fama and French (1998) and the construction of the U.S.-based risk factors follows the procedure outlined in Fama and French (1993). The reason the Australian-based risk factors follow this construction is because the *HML* risk factors are already available under this construction, so the *SMB* returns factors were computed in the same manner.

For illustrative purposes (because we cannot compare s or h across the two markets, only $s \times SMB$ or $h \times HML$) we use the annual average factor returns over all years for which data is available. For *SMB*

[19] Some firms have not been listed for the full 11-year period.

[20] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

the annual average return over 39 years from 1974 to 2012 is 3.05%. For *HML* the annual average return over 38 years from 1975 to 2012 is 7.68%.[21]

4.1.3 United States-listed firms

We analysed returns on 56 U.S.-listed energy network companies over an 11 year period from 2 January 2002 to 19 November 2012.[22] The United States sample was compiled by CEG (2013). On average these stocks have market capitalisation of US$8.0 billion and have 135 four-weekly returns in each regression (about 10 years of returns[23]). Corresponding information for each sample firm is presented in the Appendix. The United States market index is the S&P 1500.

In arriving at a set of United States-listed firms, CEG began with a set of 78 firms classified by SNL Financial (SNL) under "Power" or "Gas Utility." Of these 78 firms, one firm was excluded because insufficient financial information was available for analysis and seven firms were excluded on the basis of illiquidity. We performed the test for liquidity, which is discussed in more detail in Sub-section 4.2. This left a set of 70 firms for consideration. CEG then retained a set of 56 firms for which at least 50% of their assets were regulated.

The rationale for retaining these regulated firms was two-fold. First, CEG observed that firms with a low proportion of regulated assets appeared to have higher risk than more regulated firms.[24] Specifically, for the 14 firms with less than 50% regulated assets, the average asset beta was 0.55, compared to 0.35 for 56 firms with more than 50% regulated assets. They also observed that the less regulated firms had lower exposure in aggregate to the Fama-French factors. On an unlevered basis they estimated that for the 14 firms with few regulated assets, on an ungeared basis they had about 57% of the risk of the average firm, compared to 37% for firms with more than 50% regulated assets.

The analysis summarised above suggested to CEG that firms with regulated assets below 50% had higher risk than other firms and so they retained the 56 firms with more than 50% regulated assets. CEG also considered whether to include or exclude firms on the basis of their regulatory regime, and whether they provided electricity services, gas services or both. No firms were excluded on this basis because there was no clear evidence that the risk of firms in different regulatory regimes was different, or that there was a difference in risk between electricity and gas firms. Gas businesses had lower risk metrics than electricity businesses but there were too few gas firms to make conclusions with any statistical precision.

4.2 Liquidity

As mentioned above, the sample of U.S.-listed firms was compiled by CEG (2013), which selected firms on the basis of their industry classification by SNL and whether at least 50% of the firm's assets were regulated. There was an initial sample of 78 firms, of which one did not have sufficient financial information available to perform the liquidity analysis set out below. We then examined the liquidity of the remaining 77 firms for the reasons set out below.

[21] These annual average returns include the benefit of imputation credits on dividends, which have been assumed to have a value of 0.35 on distribution (consistent with the most recent ruling by the Australian Competition Tribunal, 2011). For the purposes of estimating *s* and *h*, however, we need to use the returns excluding imputation credits because our stock returns series also excludes the value of imputation credits. This is the same assumption adopted in the beta estimates relied upon by the AER (2009). If imputation credits were not incorporated into the annual average values for *SMB* and *HML* they would be 3.17% and 7.53%, respectively.

[22] The end date for the United States analysis of 19 November 2012 merely coincides with the date at which the estimates were compiled and does not reflect any economic event which implied that the United States series should be truncated.

[23] For firms that were not listed for the full sample period, all available returns are used.

[24] We compiled the asset beta estimates and Fama-French risk premium estimates analysed by CEG.

Some firms are much less liquid than other firms, and lower liquidity is likely to generate downwardly-biased estimates of risk exposure. The reason for this is that less liquid firms have recorded end of day prices which are less likely to reflect movements in the market or other risk factors. So the measured association between stock returns and risk factors is diminished. Less liquid stocks don't have less risk than other stocks, and in fact are likely to expose investors to more risk, but the measured association between stock returns and risk factors is dampened.

We excluded seven of the remaining 77 firms on the basis of illiquidity, measured in [three ways, which are standard metrics adopted in the literature. First, the Amihud (2002) liquidity metric is the average of the daily ratio of absolute stock return to dollar volume. All else being equal it is higher when the absolute stock returns are higher and lower when there is more stock traded. In computing the dollar volume of stock traded we used the volume weighted average price for days this was available and closing price for days when volume-weighted average price was not available. Expressed as an equation it is:

$$Amihud\ liquidity\ metric = \frac{\sum \frac{Daily\ absolute\ stock\ return}{Daily\ dollar\ volume\ of\ stock\ traded}}{Number\ of\ days\ for\ which\ a\ trade\ is\ recorded}$$

Second, we computed the bid-ask spread and third we computed the percentage of days in which there was no trade in the stock. The bid-ask spread is computed as the difference between the closing ask price and the closing bid price, divided by the average of these two prices.

We classified seven stocks as illiquid according to the following criteria. For the Amihud (2002) liquidity metric, there is a noticeable difference in the value for the seventh highest observation and the eighth highest observation. This suggests that seven of the stocks are illiquid. The stocks other than the seven identified by the Amihud metric had relatively low bid-ask spreads and traded almost every day. That is, all three metrics are consistent with the exclusion of seven illiquid stocks and the retention of the other 70 relatively liquid stocks. Consequently, we ultimately excluded seven from 77 firms on the basis of illiquidity.

Recall that the criteria for firm selection was that 50% of assets were regulated. Of the 77 firms with available data, 62 firms fit this criteria. This included six illiquid firms. The table below shows the average liquidity metrics across the two markets for sample and excluded firms. It demonstrates the material difference in liquidity amongst firms retained in the sample and firms excluded. The sample of 56 U.S.-listed firms has mean bid-ask spread of 0.12% and also has trades recorded on almost all trading days. In contrast the six excluded firms have mean bid-ask spread of 4.59% and do not trade, on average, on 14% of trading days. We tested all nine Australian firms for liquidity and did not find that any stocks should be excluded for illiquidity. The sample of 9 Australian-listed firms has mean bid-ask spread of 0.25% and had trades recorded on almost all trading days.

Table 1. Mean liquidity metrics

	Australia	United States	
	Sample	Sample	Excluded
Amihud measure	0.01	0.00	1.12
Bid-ask spread (%)	0.25	0.12	4.59
Proportion of no trade days (%)	0.29	0.00	14.03
Number of firms	9	56	6

5. Results

5.1 Estimates for individual firms

In the table below we summarise the coefficient estimates based upon analysis of individual firms. We also present standard errors and 95% confidence intervals for the re-geared estimates, based upon the dispersion of coefficient estimates across sample firms. The individual firm estimates are presented in the appendix.

For illustrative purposes we incorporated assumptions regarding *SMB* and *HML,* in order to compare the results across markets and to allow consideration of their economic significance. However, the risk premium assumptions are not meant to indicate the values which prevail at the time of writing. We have adopted the long-term average of the series used to construct the Fama-French coefficients. For Australia, these assumptions are *SMB* of 3.05% and *HML* of 7.68%. For the United States these assumptions are *SMB* of 3.58% and *HML* of 4.81%. The *SMB* and *HML* premiums across the two markets are not directly comparable because the indices used in construction are different. But we can compare the product of the coefficients and the risk premiums across markets. In other words, we can compare $s \times SMB$ and $h \times HML$ across Australia and the United States.

When comparing estimates of the total return on equity for the benchmark firm across the two markets, we report below that:

4. The estimates of the risk premium for market risk are lower for the Australian market than for the US market (i.e., a lower beta estimate for the Australian sample);

5. The estimates of the risk premium for the HML factor are higher for the Australian market than for the US market; and

6. The estimates of the risk premium for the SMB factor are economically small for both markets.

The net result is that the estimates of the total required return on equity are similar for both markets – the lower Australian estimate of the premium for market risk is offset by the higher premium in relation to the HML factor. Both samples generate similar estimates of the required return on equity.

Our view is that it is important to interpret all of this evidence holistically. As set out above, the Australian sample is too small to produce reliable estimates – there being only five live data points, compared to the US sample of 56. In our view, it would be wrong to give no weight to the large and statistically reliable US data sample and to give 100% weight to the handful of Australian data points. The Australian estimates of the relevant coefficients are statistically unreliable as they are based on such a small sample. However, even if one were to rely exclusively on the Australian estimates, the over-estimation of one risk premium and the under-estimation of another (relative to the large-sample US values) offset one another resulting in a similar estimate of the total required return on equity for the benchmark firm.

Our preferred approach is to use *all* of the relevant data, weighted appropriately to reflect the comparability of the data and the statistical reliability of the estimates – as set out in the following section.

The mean re-geared CAPM beta estimate for Australian firms is 0.60[25] and the estimate for United States firms is 0.88. A combined sample from both markets has an average of 0.84. The corresponding confidence intervals are 0.37 to 0.83 for Australian-listed stocks, 0.82 to 0.93 for U.S.-listed stocks and 0.78 to 0.90 for the combined sample. The lower standard error for the U.S.-listed firms reflects the larger number of firms available for analysis and less dispersion across the sample. The standard deviations of the re-levered beta estimates are 0.29 for Australian-listed stocks and 0.20 for U.S.-listed stocks.

With respect to the size factor, the Australian-listed firms exhibited a small, positive association with the size factor and the U.S.-listed firms exhibited a small, negative association. The re-geared coefficients are 0.03 and –0.05, respectively. As mentioned above, the value of these two coefficients (0.03 versus –0.04) cannot be directly compared, because the average value and volatility of the factor returns is different in the indices used to construct the factors. However, if we combine these coefficient estimates with long-term average values for *SMB* we can compare the risk premiums. For the Australian-listed firms, the implied premium for the size factor is 0.10%, while it is –0.17% for the U.S.-listed firms. For the combined sample the risk premium is –0.14%.

Stocks in both markets exhibited positive association with the book-to-market factor. The mean re-geared coefficients are 0.50 for Australian-listed firms and 0.11 for U.S.-listed firms. When combined with average values for *HML* in the two markets, the implied risk premiums are 3.87% for Australia-listed firms and 0.53% for U.S.-listed firms. For the combined sample the average risk premium is 0.99%.

Incorporation of the size and book-to-market factors has increased the average explanatory power of the regressions. For Australian-listed stocks the average R-squared value has increased from 11% to 14%, while for the United States-listed stocks the average R-squared value has increased from 31% to 33%.

Table 2. Mean beta estimates and leverage for individual firms

	Australia (9 comparable firms)			United States (56 comparable firms)			Australia & United States (65 comparable firms)		
<u>Capital Asset Pricing Model</u>									
Parameter	β			β			β		
Re-grd coeff.	0.60			0.88			0.84		
Standard err.	0.10			0.03			0.03		
95% CI	0.37-0.83			0.82-0.93			0.78-0.90		
Low to high	0.27-1.13			0.49-1.51			0.27-1.51		
R-squared	11%			31%			28%		
<u>Fama-French model</u>									
Parameter	β	*s*	*h*	β	*s*	*h*	β	*s*	*h*
Re-grd coeff.	0.59	0.03	0.50	0.86	−0.05	0.11	0.82		
Standard err.	0.11	0.09	0.11	0.03	0.05	0.03	0.03		
95% CI	0.32-0.85	−0.16-0.23	0.24-0.77	0.81-0.91	–0.16-0.06	0.05-0.17	0.32-0.91		
Low to high	0.26-1.26	−0.25-0.51	0.13-1.08	0.52-1.39	−0.89-0.76	−0.40-0.82	0.26-1.39		
R-squared	14%			33%			29%		
Risk prem.		0.10%	3.87%		–0.17%	0.53%		–0.14%	0.99%

For the Fama-French model, the risk premium estimates are the product of *s* × *SMB* and *h* × *HML*. The set of 65 comparable Australian and U.S.-listed firms is an estimate from placing equal weight on an Australian- and U.S.-listed observations.

[25] Recall that this estimate is based on a very small sample and the conclusion from Brooks, Diamond, Gray and Hall (2013c) is that such an estimate is statistically unreliable.

5.2 Estimates for equal-weighted indices

We repeated our estimation of risk exposure using equal-weighted indices. We use equal-weighted indices in this instance, rather than value-weighted indices, because of the risk that a small number of large firms have risk estimates different from the rest of the sample and our risk estimates essentially would become estimates for this small number of large firms. Moreover, for a set of comparable firms, all coefficient estimates are estimates of the same thing. For example, we have one estimate of the market beta for each firm in the sample. An equal weighted average gives each of these estimates the same weight. By contrast, a value-weighted average would give primary weight to a small group of large firms. Results are presented in the table below.

For the sample of Australian-listed firms, the re-geared CAPM beta estimate is 0.55[26] and the estimate for U.S.-listed firms is 0.91. The corresponding confidence intervals are 0.41 to 0.68, and 0.80 to 1.03. As with the individual firm analysis, the lower standard error for the United States index reflects the larger number of firms available for analysis. For the index, this reduces the impact of firm-specific information on the volatility of returns.

For the combined sample we report an average beta estimate of 0.86 which places 9/65 weight on the Australian index and 56/65 weight on the U.S. index, the same weights as in the individual firm analysis.[27] The 95% confidence interval is from 0.74 to 0.98.

As with the analysis of individual firms, the Australian-listed firms exhibited a small positive association with the size factor and the U.S.-listed firms exhibited a small negative association. The re-geared coefficients are 0.01 and –0.09, respectively. In combination with the *SMB* premiums for the two markets, the risk premium is +0.05% for the Australian-listed firms and –0.32% for the U.S.-listed firms. For the combined sample the average risk premium is –0.27%.

Stocks in both markets exhibited positive association with the book-to-market factor, with a re-geared coefficient of 0.36 for Australian-listed firms and 0.12 for U.S.-listed firms. When combined with average values for *HML* in the two markets, the implied risk premium is 2.79% for Australia and 0.59% for the United States. The average risk premium for the combined sample is 0.89%.

26 Again, recall that this estimate is based on a very small sample and the conclusion from Brooks, Diamond, Gray and Hall (2013c) is that such an estimate is statistically unreliable.

27 These are weights merely to construct the combined Australia & United States sample. Our conclusions are made after placing 24% weight on the Australian sample and 76% weight on the U.S. sample, which results from placing twice as much weight on an Australian observation as a U.S. observation.

Table 3. Mean beta estimates for equal-weighted indices

	Australia (9 comparable firms)			United States (56 comparable firms)			Australia & United States (65 comparable firms)		
Capital Asset Pricing Model									
Parameter	β			β			β		
Re-grd coeff.	0.55			0.91			0.86		
Standard err.	0.08			0.06			0.06		
95% CI	0.39-0.70			0.80-1.03			0.74-0.98		
R-squared	26%			58%					
Fama-French model									
Parameter	β	*s*	*h*	β	*s*	*h*	β	*s*	*h*
Re-grd coeff.	0.46	0.01	0.36	0.88	-0.09	0.12	0.83		
Standard err.	0.09	0.09	0.09	0.07	0.14	0.13	0.07		
95% CI	0.29-0.63	-0.17-0.20	0.18-0.55	0.75-1.02	-0.37-0.19	-0.13-0.37	0.69-0.96		
R-squared[28]	24%			58%					
Risk prem.		0.05%	2.79%		-0.32%	0.59%		-0.27%	0.89%

For the Fama-French model, the risk premium estimates are the product of *s* × *SMB* and *h* × *HML*. The set of 65 comparable Australian and U.S.-listed firms is an estimate from placing equal weight on an Australian- and U.S.-listed observations.

[28] In the table there is an R-squared of 26% reported for the CAPM analysis and an R-squared of 24% reported for the Fama-French analysis. But recall that we only have Australian Fama-French factors available on a monthly basis, while the CAPM estimates are based on four-weekly returns using all daily closing prices. The figure of 26% represents the average R-square from 20 regressions using four-weekly returns. When the CAPM analysis is compiled using the monthly return series used to construct the Fama-French series the R-squared is only 15%.

6. Discussion and conclusion

The analysis presented above documents coefficient estimates and risk premiums under eight alternative combinations of models (CAPM and Fama-French), samples (Australia and the United States) and estimation techniques (individual firm analysis and equal-weighted indices). The table below summarises the implied risk premium resulting from these alternative cases.

Table 4. Coefficient estimates and implied risk premiums

		CAPM	Fama-French				
		β	β	*s*	*h*	*s* × *SMB*	*h* × *HML*
Australia	Firms	0.60	0.59	0.03	0.50	0.10	3.87
	Index	0.55	0.46	0.01	0.36	0.05	2.79
	Average	0.58	0.52	0.02	0.43	0.08	3.33
United States	Firms	0.85	0.86	–0.05	0.11	–0.17	0.53
	Index	0.91	0.88	–0.09	0.12	–0.32	0.59
	Average	0.89	0.87	–0.07	0.12	–0.25	0.56
Australia &	Firms	0.84				–0.14	0.99
United States	Index	0.86				–0.27	0.89
	Average	0.85				–0.20	0.94
Parameter estimates		0.82	0.79			–0.17	1.23

For the Fama-French model, the risk premium estimates are the product of *s* × *SMB* and *h* × *HML*. The set of 65 comparable Australian and U.S.-listed firms is an estimate from placing equal weight on an Australian- and U.S.-listed observations. The parameter estimates presented in the final row are the result of placing twice as much weight on an Australian-listed observation as a U.S.-listed observation. So the weight on the Australian evidence is 18/74 = 24% and the weigh on the U.S. evidence is 56/74 = 76%.

This information needs to be distilled into final parameter estimates for the CAPM and the Fama-French model. We did not find a reason to place more or less reliance on the individual firm or index analysis, so in reaching our conclusion the two estimation techniques carry equal weight.

The next question is to consider how much weight should be placed on the evidence from Australian-listed firms and the U.S.-listed firms. In reaching a conclusion we considered the issues of comparability and reliability. Ideally we would have a large number of Australian-listed firms to analyse. But the reality is that this sample is so small that to consider it in isolation leads to estimates that are highly unreliable, as demonstrated in our companion report.[29] It should also be noted that the set of comparable firms from the United States was carefully scrutinised by CEG (2013) with respect to the proportion of assets under regulation, their industry classification and their prior use in comparable firm analysis for regulatory decision-making.

So in reaching our final parameter estimates we allowed for each observation of an Australian-listed firm to count for twice as much weight as a U.S.-listed firm. This means that the weight placed on the evidence from the Australian-listed firms is 24% [that is, 9 × 2 ÷ (9 × 2 + 56) = 0.24] and the weight placed on the estimates from the U.S.-listed firms is 76%. Placing twice as much weight on an Australian observation compared to a U.S. observation implies the following parameter estimates, presented in the last row of the table:

- For the CAPM, a beta estimate of 0.82.
- For the Fama-French model, an estimate for beta of 0.79, an estimate for *s* × *SMB* of –0.17% and an estimate for *h* × *HML* of 1.23%.

29 Brooks, Diamond, Gray and Hall (2013c).

7. References

Australian Competition Tribunal, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, May 2011.

Australian Energy Regulator, 2009. "Electricity transmission and distribution network service providers: Review of the weighted average cost of capital (WACC) parameters," May 2009.

Black, F, 1972. "Capital market equilibrium with restricted borrowing," *Journal of Business,* 45, 444–455.

Blume, M.E., 1975. "Betas and their regression tendencies," *Journal of Finance,* 30, 785–795.

Brooks, R., N. Diamond, S. Gray and J. Hall, 2013a. "The Vasicek adjustment to beta estimates in the Capital Asset Pricing Model," 22 May.

Brooks, R., N. Diamond, S. Gray and J. Hall, 2013b. "Comparison of OLS and LAD regression techniques for estimating beta," 22 May.

Brooks, R., N. Diamond, S. Gray and J. Hall, 2013c. "Assessing the quality of regression-based estimates of risk," 22 May.

Competition Economists Group, 2013, "Information on equity beta from US companies," June.

Cunningham, 1973. "Predictability of British Stock Market prices," *Journal of Royal Statistical Society Series,* 22, 315–331.

Fama, E., and K. French, 1993. "Common risk factors in the returns on stocks and bonds," *Journal of Financial Economics,* 33, 3–56.

Fama, E., and K. French, 1998. "Value versus growth: The international evidence," 53, 1975–1999.

Gray, S., J. Hall, D. Klease, and A. McCrystal, 2009. "Bias, stability and predictive ability in the measurement of predictive risk," *Accounting Research Journal,* 22, 220–236.

Henry, O., 2009. "Estimating β," prepared for the Australian Energy Regulator, 23 April 2009.

Lintner, J., 1965. "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets," *Review of Economics and Statistics,* 47, 13–37.

NERA, 2013. "The market, size and value premiums," June.

Sharpe, W., 1964. "Capital asset prices: A theory of market equilibrium under conditions of risk," *Journal of Finance,* 19, 425–442.

Vasicek, O., 1973. "A note on using cross-sectional information in Bayesian estimation of security betas," *Journal of Finance,* 28, 1233–1239.

8. Appendix

Table 5. Individual firm data for Australian-listed firms

	Descriptive information			Capital Asset Pricing Model				Fama-French model			
Name	MC	Lev	N	B_{OLS}	β_{Vas}	$\beta_{Re\text{-}g}$	RSQ	β	s	h	RSQ
SP Ausnet	2.5	62	63	0.26	0.29	0.27	7	0.39	-0.17	0.14	10
Gasnet	0.3	67	43	0.29	0.36	0.30	5	0.46	-0.07	0.41	13
DUET	1.5	76	74	0.59	0.61	0.36	16	0.35	0.01	0.21	15
Envestra	0.8	72	99	0.65	0.66	0.47	17	0.46	0.10	0.49	21
Spark	1.5	48	52	0.39	0.42	0.54	10	0.37	-0.06	0.43	10
APA	1.4	56	99	0.57	0.58	0.63	20	0.73	-0.14	0.13	19
AGL	9.0	14	42	0.32	0.36	0.77	7	1.26	-0.25	1.08	19
Alinta	1.4	37	49	0.53	0.59	0.93	8	1.03	0.39	0.71	10
HDUF	0.6	46	70	0.81	0.84	1.13	9	0.26	0.51	0.94	7
Mean	2.1	53	66	0.49	0.52	0.60	11	0.59	0.03	0.50	14

The average daily leverage of the equal-weighted index of sample firms was 60%.

Table 6. Individual firm data for United States-listed firms

	Descriptive information			Capital Asset Pricing Model				Fama-French model			
Name	MC	Lev	N	B_{OLS}	β_{Vas}	$\beta_{Re\text{-}g}$	RSQ	β	s	h	RSQ
Southern	41.4	39	138	0.31	0.32	0.49	15	0.52	-0.44	0.16	18
Consolidated Edison	18.6	44	138	0.38	0.39	0.55	19	0.57	-0.52	0.25	23
Laclede Group	0.9	43	138	0.40	0.41	0.58	15	0.53	0.43	-0.13	17
UNS Energy	1.7	66	138	0.68	0.69	0.58	26	0.56	-0.04	0.12	26
Wisconsin Energy	9.4	49	138	0.45	0.45	0.58	27	0.58	-0.10	0.08	28
Northwest Natural Gas	1.3	40	138	0.38	0.39	0.59	17	0.54	0.18	0.11	18
Northeast Utilities	12.5	58	138	0.58	0.58	0.61	29	0.60	-0.08	0.09	29
South Jersey Industry	1.6	38	138	0.45	0.46	0.71	21	0.65	0.31	0.05	23
WGL Holdings	2.1	34	138	0.44	0.44	0.73	23	0.76	-0.06	-0.26	24
New Jersey Resources	1.9	31	138	0.42	0.43	0.74	20	0.70	0.37	-0.27	22
Pepco Holdings	4.5	59	138	0.72	0.72	0.74	35	0.76	-0.27	0.04	37
Westar Energy	3.8	55	138	0.67	0.67	0.75	31	0.69	0.26	0.16	33
Centerpoint Energy	9.0	68	138	0.95	0.95	0.75	22	0.74	-0.05	0.12	24
DTE Energy	10.2	54	138	0.66	0.66	0.76	39	0.78	-0.51	0.26	43
MGE Energy	1.1	31	138	0.44	0.45	0.77	24	0.70	0.53	-0.08	27
Scana	6.3	48	138	0.59	0.60	0.77	39	0.77	-0.07	0.03	40
NV Energy	4.2	69	138	1.00	1.00	0.78	23	0.84	-0.42	-0.04	25
Piedmont Natural Gas	2.3	34	138	0.47	0.48	0.79	21	0.67	0.37	0.38	25
Atmos Energy	3.3	46	138	0.59	0.59	0.79	40	0.74	0.13	0.19	41
AGL Resources	4.7	47	138	0.60	0.61	0.80	40	0.76	0.15	0.08	42
CMS Energy	6.4	72	138	1.16	1.15	0.80	31	0.85	-0.25	-0.10	32
Vectren	2.5	46	138	0.58	0.59	0.80	32	0.85	-0.36	-0.14	34
Firstenergy	20.9	48	138	0.60	0.61	0.80	21	0.91	-0.89	-0.04	27
Southwest Gas	2.1	55	138	0.72	0.72	0.82	44	0.75	0.18	0.29	46
Avista	1.6	55	138	0.73	0.74	0.83	31	0.71	0.53	0.31	36
Nisource	7.2	58	138	0.80	0.81	0.84	43	0.83	-0.34	0.37	47
PPL	16.7	44	138	0.60	0.61	0.84	25	0.97	-0.69	-0.40	31
Portland General Elec.	2.0	48	83	0.65	0.66	0.85	43	0.83	0.38	-0.23	46
CH Energy Group	1.0	35	138	0.51	0.52	0.85	23	0.78	0.48	-0.04	25
Xcel Energy	14.1	53	138	0.71	0.72	0.85	24	0.88	-0.23	-0.03	25
Nextera Energy	29.2	42	138	0.59	0.60	0.86	30	0.94	-0.61	-0.11	34
El Paso Electric	1.3	45	138	0.62	0.63	0.86	28	0.75	0.12	0.58	32
Entergy	12.6	41	138	0.58	0.59	0.87	29	0.94	-0.82	0.19	35
Idacorp	2.1	49	138	0.69	0.70	0.89	33	0.90	-0.06	-0.09	34
Empire District Electric	0.9	47	138	0.67	0.67	0.89	40	0.80	0.47	0.17	43
Northwestern	1.4	47	100	0.67	0.67	0.90	33	0.85	0.44	-0.18	35
Ameren	8.1	44	138	0.65	0.65	0.91	35	0.95	-0.48	0.13	37
Edison International	14.9	54	138	0.80	0.81	0.94	35	0.95	-0.23	0.10	36
Alliant Energy Corp	5.2	42	138	0.64	0.65	0.94	29	0.88	-0.01	0.34	31
Pinnacle West Capital	5.8	48	138	0.73	0.73	0.95	36	0.95	-0.11	0.10	37
PG&E	19.0	44	138	0.67	0.68	0.95	22	0.91	0.27	0.03	23
Public Svs Enterprise Gr	16.5	44	138	0.69	0.69	0.97	26	1.00	-0.33	0.00	27
American Electric Power	20.2	52	138	0.80	0.81	0.98	33	1.03	-0.40	-0.03	34
Teco Energy	3.9	53	138	0.85	0.86	1.00	32	0.96	-0.11	0.36	33
ITC Holdings	3.8	46	91	0.75	0.76	1.03	34	1.09	-0.54	0.08	36
UIL Holdings	1.9	47	138	0.78	0.78	1.04	31	0.87	0.38	0.82	38
Integrys Energy Group	4.7	43	138	0.72	0.73	1.05	34	1.00	-0.20	0.50	36
Duke Energy	46.1	44	138	0.75	0.76	1.07	31	1.13	-0.71	0.08	35
OGE Energy	5.3	41	138	0.74	0.74	1.09	41	1.02	0.04	0.49	44
Cleco	2.6	45	138	0.79	0.80	1.10	34	1.05	0.21	0.15	35
Great Plains Energy	3.0	46	138	0.84	0.84	1.13	49	1.13	-0.25	0.18	49
PNM Resources	1.6	57	138	1.08	1.07	1.16	38	1.12	0.03	0.28	39
Sempra Energy	16.7	39	138	0.80	0.80	1.22	41	1.31	-0.53	-0.17	44
Black Hills	1.4	48	138	0.95	0.95	1.24	41	1.14	0.43	0.34	44
Allete	1.6	30	138	0.77	0.78	1.36	38	1.24	0.55	0.30	40
Otter Tail	0.8	32	138	0.88	0.89	1.51	36	1.39	0.76	0.16	38
Mean	8.0	47	135	0.67	0.68	0.88	31	0.86	-0.05	0.11	33

The average daily leverage of the equal-weighted index of sample firms was 47%.

9. Terms of reference and qualifications

This report was prepared by Professor Stephen Gray and Dr Jason Hall. Professor Gray and Dr Hall have made all they enquiries that they believe are desirable and appropriate and that no matters of significance that they regard as relevant have, to their knowledge, been withheld.

Professor Gray and Dr Hall have been provided with a copy of the Federal Court of Australia's "Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia." The Report has been prepared in accordance with those Guidelines, which appear in the terms of reference.