Cost of equity estimates implied by analyst forecasts and the dividend discount model

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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

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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. Overview

2.1 Context

We have been engaged by a consortium of Victorian Distribution businesses (Citipower, Powercor, United Energy, SP AusNet and Jemena) to provide an estimate of the expected return on the market and the market risk premium using the dividend growth model. An earlier version of this report was submitted in August 2013. In this report we use an additional two months of data, refer to recent papers released by the Australian Energy Regulator (AER, 2013a) and the Independent Pricing and Regulatory Tribunal (IPART, 2013), and refer to a recent report we prepared in which we reconcile the main methodological differences between our analysis and that conducted by the AER (SFG Consulting, 2013b).

The term *market risk premium* means the difference between the expected return on the market and the risk free rate, measured in this report as the yield to maturity on ten-year government bonds. The term *dividend growth model* refers to a model whereby the price of shares is estimated as the present value of expected dividends. The term "dividend growth" specifically refers to dividend forecasts as a function of short-term dividend expectations and growth in those dividends. It should be noted at the outset that the term dividend growth model does not imply that dividends are expected to grow at a constant rate in every forecast year. To ensure that this terminology is not misinterpreted, throughout the report we use the more general term *dividend discount model* to refer to the valuation of shares as the present value of expected future dividends.

We have been asked to provide estimates of the expected return on the market and market risk premium over two specified time periods. These time periods are 1 January 2013 to 30 June 2013 and 1 July 2002 to 30 June 2013. To facilitate this we present results over six month intervals from the second half of 2002 (2H02) to the first half of 2013 (1H13).[1]

Estimating the cost of equity in this manner is analogous to estimating the yield to maturity on debt as a function of bond prices and expected payments to lenders. The challenge in applying this approach to equity is that the expected dividend stream is less certain than the expected cash flow stream to lenders. There may be differing assumptions which can be made about the growth in dividends, which correspond to a larger number of estimates for the cost of equity relative to those for the cost of debt. In this report we present results using an estimation technique which mitigates imprecision in cost of equity estimates using the dividend discount model, and which allows inferences to be drawn from a large amount of data.

Our estimates of the market return represent an estimate of the return that investors require from dividends and capital gains. If the Australian Energy Regulator (AER) assumes that imputation credits have a positive value, then the cost of equity is higher than presented here. So the cost of equity estimates presented in the main body of this report are what equity investors expect in the absence of any of these tax benefits. In Appendix 7.2, we document the amount by which required returns need to increase in order to provide investors with the estimated return from dividends and capital gains.

2.2 Alternative versions of the dividend discount model

Our estimates are derived under the assumption that growth reverts to a sustainable level over time. We refer to this as mean-reversion in parameter inputs. An alternative version of the dividend discount model is the case of constant growth, whereby expected dividends in the first forecast year are expected

[1] The first period for which an estimate can be made is the second half of 2002, due to data availability. At the time of writing the most recent available data ends on 13 June 2013.

to grow at a constant rate in perpetuity. We do not present estimates assuming constant growth from the first forecast year, for reasons summarised below and expanded upon in the report.

The constant growth case is the simplest case to explain. While this makes the model easy to understand, the constant growth assumption is the limitation of this version of the model. Even though individual firms may not necessarily be growing at a rate expected to be maintained in perpetuity – some are experiencing high growth and others low growth – a constant growth assumption has the potential to be a reasonable approximation for valuation for mature firms. For example, suppose a firm was expected to have dividend growth of 10% in year one, 8% in year two and 6% thereafter, and the cost of equity was 12%. It is arguable that this is approximately the same as assuming dividend growth of 6.303% in perpetuity.[2]

The problem is that we cannot use our subjective judgement to determine how close an individual firm is to a constant growth state. If we already know what the long-term growth rate is for a firm in steady state, we do not need to estimate this. But we do not know what the market is expecting for long-term dividend growth, so we cannot simply include or exclude firms from analysis on the basis that they are in a steady state or not. Equally, we cannot rely upon an assertion as to what is the "right" level of growth. This can easily be replaced by another plausible growth assertion.

What we can do is implement a process whereby growth reverts to a sustainable level over time, and have this sustainable level determined by the data. We allow return on investment, the cost of equity, and the long-term growth rate, to take on a range of values, and then determine which joint set of inputs provides the smoothest transition to long-term growth.

2.3 Application of dividend discount models in recent regulatory reviews

2.3.1 Issues of debate in regulation

The application of the dividend discount model has been the subject of considerable debate amongst regulators in recent times. There are two main sources of contention. The first source of contention concerns the appropriate level of long-term growth that investors expect. The second source of contention relates to the reliability of cost of equity estimates derived from market prices and expectations.

2.3.2 Reasonable growth rates

A large amount of debate in this area stems from disagreement about what is a reasonable value to assume for the long-term rate of growth. For instance, we have been specifically asked to address the submissions of Lally (2012, 2013) that an upper bound on the plausible long-term growth rate is the rate of growth in Gross Domestic Product (GDP). In August 2013 the AER (2013a, p.221) compiled dividend discount model estimates for the Australian market under the assumption that long-term dividend growth is expected to be 1% below an estimate of GDP growth, estimated with respect to historical average GDP growth.

The papers written by Lally and the conclusion of the AER need to be placed in the context of the following three assumptions. First, GDP growth is a starting point to estimate long-term growth in earnings per share for the Australian equity market. Second, the long-term average growth rate for

[2] Specifically, if the dividend profile is $1.10 in year one, and grows 8% to $1.19 and continues to grow at 6% thereafter, the present value of expected dividends is $18.66, computed as $\$1.10 \div 1.12 + \$1.19 \div 1.12^2 + \$1.19 \times 1.06 \div (0.12 - 0.06) \div 1.12^2 = \$0.98 + \$0.95 + \$16.73 = \$18.66$. We have the same valuation if dividends grow at 6.303% in perpetuity, computed as $\$1.00 \times 1.06303 \div (0.12 - 0.06303) = \$18.66$.

firms currently listed is expected to be materially below the long-term growth rate of other firms (1% lower growth is one third of the AER's assumption that real GDP growth is expected to be 3%). Third, it is appropriate to estimate long-term growth entirely with respect to an historical time series, and therefore make an estimate of long-term growth that is entirely independent of share price, earnings expectations and dividend expectations.

Arguments about the "correct" assumption for long-term growth generally flow from considering growth in isolation, without reference to the level of share prices and expectations for earnings and dividends. The exercise of dividend discount model analysis is to determine what prices, earnings and dividends imply about the market's cost of equity and the market's expectations for growth. The exercise is not to determine what the market "should" be assuming about the cost of equity and growth.

For example, the average price/earnings ratio for the Australian market was 23 times during the calendar year 1999, compared to 17 times from 1 January 1987 to 13 August 2013.[3] The high prices observed in 1999, relative to earnings, either (a) incorporate a cost of equity *below* historical average returns, (b) expectations for growth that are *above* historical growth rates, or (c) some combination of both. It is not appropriate to simply assume that market expectations for growth are capped according to historical realised growth rates, and then determine that the cost of equity must be below historical realised returns. We could equally assume that the cost of equity is formed on the basis of historical realised returns, and then determine that growth expectations are above what has been previously observed.

Our analysis does not rely upon an assumption about growth. Growth expectations are an output from the analysis and are estimated jointly with the estimates for the cost of equity. They are also estimates of growth that are expected to prevail after a ten-year explicit forecast period and are a function of expected reinvestment rates and expected return on those reinvested earnings.

2.3.3 Reliability of estimates

Amongst Australian regulators there is an increasing recognition that dividend discount model estimates of the cost of equity have a role to play in estimating the market cost of equity. However, as this recognition has only recently occurred, and not been specifically adopted in determinations, it is unclear exactly how much consideration will be given to dividend discount model estimates of the cost of equity. There has been recent consideration of this issue by the Queensland Competition Authority (QCA, 2012), the Independent Pricing and Regulatory Tribunal in NSW (IPART, 2013), the AER (2013a) and the Economic Regulation Authority (ERA, 2013) in Western Australia. In some instances the reliability of cost of equity estimates derived from share prices has been called into question.

As one example, in a recent consultation paper the AER (2013b, pp.93 to 95) refers to recent submissions made to it and advice on market cost of equity estimates using versions of the dividend discount model. It raises a concern over the "variability of dividend growth model estimates over a short period of time." In this regard it refers to estimates from CEG (March and November 2012), Capital Research (February and March 2012), NERA (February and March 2012) and Lally (March 2012). The range reported by the AER is 11.7% to 13.3% excluding Lally's estimates. The range of estimates provided by Lally (2013) is 9.2% to 11.7%. Subsequent to this paper, the AER (2013a, pp.220 to 222) stated that it will give consideration to dividend discount model estimates in estimating the market cost of equity (and by extension the market risk premium). However, in the absence of an actual determination, it is unclear how the AER will take into consideration dividend growth model estimates,

[3] We compiled the price/earnings ratio for the All Ordinaries Index on a daily basis over this 26.6 year time period, as reported by Datastream.

given that it has indicated that it will also look to what it considers are other sources of information on the cost of equity, such as historical average returns.

The Queensland Competition Authority (QCA, 2012) states that it does give consideration to dividend discount model estimates of the market cost of equity. It incorporates mean-reversion in dividend growth to estimates of long-run GDP. It performs a number of computations, allowing convergence to take place over periods of 5, 10, 15 and 20 years, and allows real long-term growth to take on values of 2.5%, 3.0% and 3.5% (QCA, 2012, pp. 23 – 24).[4]

IPART (2013) has decided to incorporate several dividend discount model estimates of the market cost of equity into its decision-making. It will compile six estimates of the market risk premium based upon contemporaneous market data. Five of these estimates are dividend discount model estimates and the sixth estimate is based upon four directional market indicators. The dividend discount model analysis presented in the current report is an updated analysis of the analysis we compiled for IPART and which has been incorporated into IPART's decision. The directional indicators method used by IPART was also based upon analysis we presented to IPART.[5] IPART will then estimate a range for the market risk premium (based upon contemporaneous information) bounded by the upper and lower bound of these six indicators. IPART will also rely upon a range for the market risk premium of 5.5% to 6.5% based upon historical average returns.

The Economic Regulation Authority (ERA, 2013, pp.124 to 125) rejected the use of the dividend discount model on the basis that the inputs into the estimation, based upon broker reports, may be unreliable and that the model is not based upon a strong theoretical foundation. However, it does intend to place some reliance on survey evidence of the market risk premium (p.135).

The differing consideration given by the four regulators to dividend discount model estimates of the cost of equity illustrate variation in the regulators' assessment of the reliability of those estimates. Some particular comments are warranted.

At one extreme, the ERA's outright rejection of estimates derived from this technique, on the basis of its theoretical underpinnings, is highly questionable. The theory relied upon is that the price of an asset can be estimated as the present value of expected cash flows, which is the entire basis for the setting of regulated prices and the technique used to estimate the risk free rate and the cost of debt capital.

This basis for rejection is also at odds with the use of survey evidence to inform estimates of the expected market return. According to the ERA assessment, it considers survey evidence to be more reliable than a quantitative assessment of the expected market return. Surveys are conducted amongst a number of people, including academics, chief financial officers, investors and equity research analysts. The latter two groups of participants are the same people trading shares and therefore setting share prices, and the analysts making forecasts of earnings and dividends on those shares. It is highly questionable to rule out any consideration of the cost of equity derived from prices and expected earnings and dividends, but also place weight on the survey responses of the same participants setting those prices and making those earnings and dividend forecasts. This leaves us with survey responses of

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[4] The QCA places 25% weight on the market risk premium derived from this estimate, but then rounds its final estimate of the market risk premium to the nearest percentage point. The result of this averaging and rounding procedure is that it is highly unlikely that the QCA estimate of the market risk premium will deviate from 6% on the basis of its dividend discount model estimate.

[5] The other three dividend discount model estimation techniques used by IPART rely upon assumptions regarding the long-term rate of growth and are described by Panigirtzoglou and Scammell (2002), Inkinen, Stringa and Voutsinou (2010) and Damodaran (2013). The directional indicators approach relies upon four indicators of the market risk premium – the term spread (the difference in yield on long-term versus short-term government bonds), the corporate debt spread (the difference in yield on corporate bonds versus government bonds), the risk-free rate and the dividend yield. We computed the percentile rank of each indicator using historical data and then applied this to a range for the market risk premium of 3% to 9%, assuming a uniform distribution. For example, if the corporate bond spread was at the 75th percentile, the implied market risk premium is 7.5%. For details, see SFG Consulting (2013a).

people more removed from market conditions than investors and equity research analysts. While the ERA has not made an explicit statement as to how it will use survey responses, it is difficult to see how the quantitative information conveyed by market prices and earnings forecasts can be considered entirely unreliable, but survey responses will be considered relevant information.

With respect to the other three regulators (QCA, AER and IPART), their consideration or partial adoption reflects their consideration of the reliability of dividend discount model estimates relative to estimates derived from alternative techniques. One alternative technique is the historical average realised return, relative to government bond yields.[6] The other is survey evidence.

The variation in the range of estimates discussed by the AER, above, is the basis for questioning the reliability of dividend discount model estimates. The issue is whether an estimation technique can be considered reliable if such a range of outcomes can be generated over a reasonably short period of time, and from different sources over the same period of time.

With respect to variation over time, it is not obvious what should be the correct amount of variation in the cost of equity estimates over time. Estimates of the cost of equity will vary over time because of variation in the true cost of equity, and imprecision in the measurement of the true cost of equity. So it is not appropriate to attribute all of the variation in estimates of the cost of equity to the use of the dividend discount model.

In addition, the dividend discount model, if implemented appropriately, will result in estimates that exhibit less variation over time than under the AER's current approach.[7] The AER has only ever deviated from an assumption that the market risk premium equals 6% on one occasion, coinciding with the global financial crisis. The AER increased the market risk premium estimate to 6.5% during this period. So unless we see an economic event of this magnitude again, we can reasonably assume that the current approach is simply to add 6% to the yield on 10-year government bonds. This means that the variation in the market cost of equity over time will match the variation in interest rates. As will be observed later, our estimates of the market cost of equity are less variable over time than what would be observed by simply adding 6% to the yield on 10-year government bonds.

Furthermore, the AER's preferred implementation of the dividend discount model will lead to estimates of the market cost of equity that are almost perfectly correlated with the dividend yield in the second forecast year. The AER has a preference for a model in which constant growth in dividends occurs from the third forecast year onwards, and at an assumed, fixed growth rate.[8] The dividend expectation in the first forecast year will have a relatively small impact on the cost of equity. So, essentially, the AER's preferred dividend discount model technique is approximately the same as adding a constant growth rate to the dividend yield based upon the second year dividend.

With respect to variation of estimates across different advisors making those estimates, these generally reflect divergence of opinion as to how long-term growth expectations should be measured. Specifically, according to the figures quoted by the AER: (1) CEG (2012a and 2012b) made an estimate of the cost of equity for the market of 12.3% (at a point in time of December 2011) and 11.9% (at a point in time of September 2012); (2) NERA (2012) made an estimate of the cost of equity for the market of 11.7% in February and March 2012; and (3) Capital Research (2012a, 2011b) provided

[6] The QCA also uses a version of historical returns in which it excludes an estimate of unanticipated inflation.

[7] It is worth re-iterating that an appropriate approach is not to simply add a constant estimate of long-term growth to the dividend yield. This approach assumes that growth expectations are entirely independent of the dividend yield. The dividend yield could be low because the cost of equity is low or growth expectations are high. The dividend yield could be high because the cost of equity is high or growth expectations are low.

[8] AER (2013a), Sub-section H.2, pp.220 to 221.

estimates of the cost of equity for the market within the range of 11.7% to 13.3%, based upon alternative assumptions for completeness, as discussed below.

These figures show that the CEG estimate fell by just 0.4% over the course of nine months and there was a stable estimate from NERA over two months. There was also no variation between the estimates provided by Capital Research in reports they submitted in February 2012 and March 2012. The estimates provided by Capital Research reflect variation in assumptions regarding the value of imputation credits as well as variation in dividend yields over time. Of the 1.6% difference between the two estimates reported above, about 1.0% represents variation in dividend yield estimates over a period of a little over two years, and the remaining 0.6% represents variation due to possible values for imputation credits. Merely presenting for the regulator what outcomes could be under a set of alternative tax assumptions is not a valid criticism of the dividend discount model.

Specifically, Capital Research report an average dividend yield of 5.23% from October 2009 to January 2012 and an average dividend yield of 6.29% at the end of December 2011. Both these yield estimates are based upon an assumption that distributed credits are worth 35 cents in the dollar and about 75% of dividends are franked. So the difference in yields under a consistent assumption is just over 1% for these two estimates. A lower dividend yield assumption of 4.70% excludes any value for imputation credits. The range of 11.7% to 13.3% comes from adding a constant 7% growth rate to the lower yield assumption of 4.70% and the higher yield assumption of 6.29%.

The limitation of the CEG computation and the Capital Research computation, and the source of time series variation, is the simple addition of a constant growth assumption to the dividend yield. In the CEG analysis this assumption was 6.6% and in the Capital Research case this assumption was 7.0%. The use of a constant growth assumption, estimated independently of share prices, will overstate the sensitivity of the cost of equity estimates to share price movements. As mentioned above we do not draw conclusions from a constant growth model and would not endorse simply adding a constant growth rate to a point-in-time dividend yield.

The ranges of estimates provided by Lally of 9.2% to 11.7% simply reflects a range of potential assumptions regarding long-term growth. These estimates vary due to assumptions about how the growth rates for a typical firm might vary relative to overall GDP growth, and how long it takes for a firm to reach steady state. We could equally derive a wide range of potential estimates for market returns from the variation in historical market returns or from variation in survey responses. For instance, suppose the standard error of market returns in historical data was 1.5%. We could argue that the cost of equity, derived purely from the variation of returns in this sample, was within a 3.0% range simply by considering one standard error either side of the mean.

The reason that the estimates from Lally are somewhat lower than the estimates from other sources is that Lally takes a more conservative view on the long-term growth rate in dividends. He shows that there will be higher cost of equity estimates if (1) we assume relatively higher growth, and (2) it takes longer to reach this steady state of growth. None of the analysis outlined above considers the detailed firm- and analyst-specific information we consider, nor does it account for the entire process by which each firm generates earnings and dividends over the forecast horizon. It is this detailed modelling process that mitigates variation in outcomes based upon what growth rate the analyst considers "should" be possible.

2.4 Differences in approach

The important implication of the preceding discussion is that estimating the market cost of equity by applying (a) a constant growth version of the dividend discount model, to (b) aggregate market data, is challenging, because it requires a simultaneous estimate of two inputs – the cost of equity and the long-term growth rate. Prior applications have attempted to overcome this challenge by proposing "reasonable" expectations for long-term growth, which leads to two problems.

First, one basis upon which a long-term growth projection could be considered reasonable is some measure of average historical growth rate, such as GDP or earnings. But even if researchers could agree to use an historical average of something, there is debate about what that something should be.
Second, the very imposition of long-term historical growth rates to terminal growth rates assumes that the market forms expectations of growth from history, but expectations for returns are independent of history. Specifically, if we observe a high price/earnings ratio, this could be because the market has high expectations for growth or because it has low required returns. Instead of assuming long-term growth is equal to an historical average, and estimating a timely cost of equity, we could just as easily assume expected returns are equal to long-term average realised returns, and estimate a timely expectation for growth.
The method we adopt is designed to overcome this challenge. The basis for our approach is to simultaneously estimate the cost of equity and the long-term growth rate, rather than having either parameter imposed on the analysis. In implementing this process, our analysis differs from prior papers in a number of respects.

First, with respect to problem of "reasonable" growth estimates, we have implemented a process and applied that process to a dataset which avoids reliance upon historical growth rates. Our estimate of the market cost of equity is aggregated from an estimate for each individual listed firm. In turn, the cost of equity estimate for each individual firm is derived from an average of eight analyst forecasts over a six month period. Our dataset comprises 42,366 analyst forecasts of earnings, dividends and share prices over an 11 year period. What we do with this data is implement a specific process for projecting earnings per share and dividends per share over all future years, which considers reinvestment and returns on those investments.

This detailed analysis allows us to reach conclusions about the market cost of equity without the subjective assessment of what level of growth appears reasonable. The long-term growth estimate for each firm is consistent with a set of initial expectations for earnings and dividends, and a process by which parameter inputs revert to long-term values. It is not an estimate based upon a level that we consider reasonable.

Second, we have addressed the perceived concern over unreliability of the cost of equity estimates, which is generally based upon the variation in estimates over time and across researchers making those estimates. We compare the time series variation in our market estimates to those reported by Bloomberg and the estimates that would prevail by simply adding 6% to the 10 year government bond yield, which is the approach adopted by the AER. We show that estimates derived using our technique exhibit less variation over time than these alternative approaches. It is not obvious just how much we should expect the market cost of equity to vary over time, because this is what we are trying to estimate. But the point is that dividend discount model estimates should not be rejected for exhibiting variation over time when they are less variable than an alternative approach.

With respect to variation across researchers making estimates, as discussed above, we mitigate the component of variation associated with those researchers' subjective assessment of reasonable growth rates. We also demonstrate that, across individual firms, our estimates of the cost of equity exhibit less dispersion than we would observe under the application of the CAPM. So the dividend discount model estimates should not be rejected on the basis that individual firm estimates exhibit too much dispersion, because they exhibit less dispersion than observed under the AER's current approach.

2.5 Reconciliation of our estimation technique with the preferred technique of the AER

In its Draft Rate of Return Guideline the AER (2013a) gave little consideration to the process by which we estimate the market return using the dividend discount model describing it as "excessively complex (p.220)." We do not consider this characterisation to be appropriate. In order to assist in understanding our approach we complied a report for the Energy Networks Association entitled *Reconciliation of dividend discount model estimates with those compiled by the AER*. In this report we disaggregated our method into four important methodological differences between our approach and the approach favoured by the AER. We documented how each of those important methodological choices could be adopted independent of each other choice, and how each methodological choice is likely to lead to an increase in the estimate of the market cost of equity. These four important methodological choices are summarised below. We recommend reading the full text of our reconciliation report, along with the current report, for a complete understanding of our estimation technique and assumptions.

- **Horizon.** Rather than assume long-term growth will begin from year three onwards, assume that long-term growth begins in forecast year ten, and gradually shift parameter estimates towards long-term inputs. The increased complexity from this step is minimal and is consistent with the AER's rationale that long-term growth for currently listed firms lies below the long-term growth in the economy, because the AER considers that new companies are expected to have above-average growth.

- **Price.** Rather than match analyst dividend forecasts with share prices, match analyst dividend forecasts with price targets. There is no increase in complexity associated with this approach, as it is simply a matter of replacing one price input with another. It is more likely that the analyst price target (rather than the share price) reflects the present value of expected dividends made by that same analyst. When consensus dividend forecasts are used, rather than individual analyst forecasts, this issue is less troublesome.[9] But at the margin we still recommend the use of price targets as the more appropriate price.

- **Growth.** Rather than impose a growth rate that is made independent of price, earnings and dividend forecasts and then solve for the cost of equity, jointly estimate long-term growth and the cost of equity. This technique involves using a program to simultaneously solve for more than one input, so there is some increase in complexity, but there are substantial benefits. In a large sample it is a matter of finding inputs that fit the data for many cases. So there are more computations, but each computation itself is not complex. Most importantly, it means that the cost of equity estimate is no longer almost perfectly correlated with the dividend yield. So the market cost of equity estimate is likely to be more stable over time.

- **Timing.** Match the timing of analyst earnings and dividend forecast entries into the database with prices observed on or close to the same date. The longer the time between when an analyst makes a dividend or earnings forecast and when the price is observed, the more volatile will be the cost of equity estimate over time. Share prices change because of changes in dividend expectations and changes in the cost of capital. The greater the lag between when forecasts are made and the price date, the more the price change will *appear* to be due to changes in the cost of capital. Making this change is purely a data compilation exercise. There are no computations involved. It is simply a matter of compiling a set of prices and analyst earnings and dividend forecasts made on close to the same date. This is one important reason why our estimates of the cost of equity over time are more stable than those compiled by the AER and Bloomberg.

[9] There are two types of analyst forecast data that can be used in dividend discount model estimates of the cost of equity – individual analyst forecasts (for example, analyst Jack makes an earnings per share forecast for BHP, and analyst Jill makes an earnings per share forecast for ANZ), and consensus analyst forecasts (for example, the mean or median analyst earnings per share forecasts for BHP and ANZ).

2.6 Estimates

2.6.1 Sample and time period

Our estimates are formed from a sample of 4,835 observations over the 11 year period from the second half of 2002 (2H02) to the first half of 2013 (1H13), formed from 42,366 analyst inputs. That is, each analyst providing a joint set of forecasts (price target, earnings per share forecast, dividend per share forecast) is one analyst input, which results in one cost of equity estimate. We average all cost of equity estimates for each firm in each six month period, resulting in 4,835 average cost of equity estimates[10] This represents the entire time period for which data is available. For each Australian-listed firm we compiled dividend forecasts, earnings forecasts and price targets for all analysts covering that firm, every six months, and used all firms for which data was available. There are 579 individual firms in the analysis, so on average each firm appears in the dataset about eight times. In each six-month period there is an average of 220 firms in the sample.

We draw conclusions about the market cost of equity estimates over time, and make specific reference to the difference in cost of equity estimates over two distinct time periods. These time periods are from 2H02 to 1H08 and 2H08 to 1H13. In the second half of 2008, equity markets fell substantially, government bond yields fell over a sustained period of time, and the subsequent period has been labelled the global financial crisis. Hence, we should expect an increase in the cost of equity and the market risk premium in the second time period. We also make specific reference to the estimates for the first half of 2013 which represents the best estimate of the prevailing cost of equity at the time of writing.

A term that has come into common use in regulation is *forward-looking rate of return*. This has been used to distinguish between an expected return based upon current market conditions ("What is the required return looking forward?") and realised returns in an historical time series ("What return did investors earn in prior years?"). Using this terminology, the yield to maturity on debt at each point in time is a forward-looking rate of return, and our cost of equity estimates are a forward-looking rate of return. When we refer to the entire 11-year time period from 2H02 to 1H13, we refer to a series of 22 estimates of the forward-looking rate of return, formed every six months. When we refer to the most recent period of 1H13, this is our best estimate of the cost of equity currently prevailing in the market.

2.6.2 Imputation

It is important to note the difference between the cost of equity estimates we derive from earnings forecasts, dividends and price targets, and the required cost of equity under regulation. This difference relates to the assumed value of imputation credits. Our cost of equity estimates are based upon projections of earnings and dividends that exclude any benefits of imputation, so represent the return equity investors expect to receive from dividends and capital gains. In contrast, the equity component of the regulated return is derived from an assumption that imputation credits provide investors with some value, and so the cost of equity excluding these imputation benefits is a lower number.

In Appendix 7.2 we document that the regulated rate of return, according to the AER's post-tax revenue model, needs to be computed by dividing these estimates by 0.9032 (assuming a corporate tax rate of 30% and that imputation tax credits are assigned a value of 0.25).[11] This adjustment is required in order for investors to expect to receive a return from dividends and capital gains of the estimated cost of equity.

[10] At the time of writing, data is available up until 13 June 2013.

[11] If imputation credits are valued at 0.50 the corresponding divisor is 0.8235.

So to avoid misinterpretation, we use the following terminology. The cost of equity we derive from analysis of earnings forecasts, dividend forecasts and price targets is referred to as the *cost of equity excluding imputation benefits*. The difference between this estimate and the risk free rate is referred to as the *market risk premium excluding imputation benefits*. As the AER needs to set a higher number in order to match this cost of equity excluding imputation benefits, we refer to this higher number as the *cost of equity for regulation*.

2.6.3 Estimates over the entire sample period

The average market cost of equity excluding imputation benefits over the 22 half year periods from 2H02 to 1H13 is 10.6%. The average yield on 10 year government bonds was 5.2% over this period so the estimated market risk premium excluding imputation benefits is 5.4%.[12] The impact of the global financial crisis in the second half of 2008 suggests that the cost of equity should be higher subsequent to this point. This is what we observe in the results. For the six years from 2H02 to 1H08 the average estimated cost of equity is 10.3%, with the value increasing to 10.9% during the five years from 2H08 to 1H13. The average estimated market risk premium increases from 4.7% to 6.2%.

In Appendix 7.2 we document that the regulated rate of return, according to the AER's post-tax revenue model, needs to be computed by dividing these estimates by 0.9032 (assuming a corporate tax rate of 30% and that imputation tax credits are assigned a value of 0.25).[13] This adjustment is required in order for investors to expect to receive a return from dividends and capital gains of the estimated cost of equity. **So the cost of equity for regulation is 11.7% (that is, 0.106 ÷ 0.9032 = 11.7%).**[14]

2.6.4 Estimates for the most recent six month period

During the final six months of our sample period, the market cost of equity excluding imputation benefits was estimated at 10.2%, which is a premium of 6.8% over average government bond yields of 3.4%. The implied estimate of the cost of equity under regulation is 11.3% (that is, 0.102 ÷ 0.9032 = 11.3%).[15] These figures represent the most relevant estimates of the prevailing cost of funds, and market risk premium, at the time of writing.[16]

[12] These figures of 10.6% and 5.4% represent the return from dividends and capital gains only, and the excess of this return over government bond yields. If imputation credits are assumed to have a positive value, the total required return needs to be grossed-up above these levels. This adjustment is discussed in a subsequent section of the report.

[13] If imputation credits are valued at 0.50 the corresponding divisor is 0.8235.

[14] If imputation credits are valued at 0.50 the cost of equity for regulation is 12.8% (that is, 0.106 ÷ 0.8235 = 12.8%).

[15] If imputation credits are valued at 0.50 the cost of equity for regulation is 12.4% (that is, 0.102 ÷ 0.9032 = 12.4%).

[16] Our estimates for the most recent period are based upon earnings and dividend forecasts for the period 1 January 2013 to 13 June 2013. Had analysis been conducted using information from 14 June 2013 to 14 October 2013 there is no reason to think that the cost of equity estimates would be materially lower or higher. Over this period we have observed small positive changes in dividend yields and earnings yields. Using the consensus expectations for dividends and earnings on the ASX200 compiled by Bloomberg, we can compare dividend yields and earnings yields for these two time periods. With respect to dividend yields based upon one year dividend forecasts, the average daily dividend yield is 4.73% for the period 1 January 2013 to 13 June 2013. This increases to an average 4.95% for the period from 14 June 2013 to 14 October 2013. For dividend yield based upon year two dividends the average values are 5.10% and 5.35% (an increase of 0.25%); for earnings yield based upon one year earnings the average values are 7.40% and 7.52% (an increase of 0.12%); and for earnings yield based upon year two earnings the average values are 8.08% and 8.11% (an increase of 0.02%).

3. Alternative versions of the dividend discount model

3.1 Introduction

Cost of equity estimates derived from analyst forecasts are often referred to as *dividend growth model* estimates. The reason for this terminology is that the task is to estimate the cost of equity after accounting for near term dividend forecasts, typically from one to three years, and the growth in those dividends over time. However, it is important to understand that there is no requirement that dividends grow at a single, constant rate outside of this near term forecast horizon. To avoid misinterpretation we use the more general term *dividend discount model* to refer to the valuation of shares as the present value of expected dividends.

The conceptual task is relatively straightforward to understand. It is analogous to estimating the yield to maturity on corporate bonds as the discount rate which sets the present value of payments to bond holders equal to the bond price. The application, however, is more challenging because we need to estimate a perpetual series of dividends, despite only having a short series of dividend and earnings expectations from analyst forecasts. This means that we need to *jointly* estimate a series of dividends and a cost of equity. The dividend series will be determined, in the short term, by analyst expectations of earnings and dividends per share. But outside of this explicit forecast period, the dividend series will be determined by expectations for growth of those dividends. Depending on the model adopted there could be one or more growth stages. The reason we refer to this as a *process* by which dividends evolve is to emphasise that growth does not need to be constant at any particular stage or in perpetuity. While convenient for computations, constant growth is just one process by which dividends could evolve.

The most important issue to understand about growth expectations is that these cannot be arbitrarily imposed on the analysis on the basis of what is considered reasonable by the person undertaking the task. What is being estimated are the growth rates incorporated into share prices set by the market, not imposed on the analysis from an external source.

The caution against imposing a growth rate on the analysis according to the researcher's or analyst's view as to what is correct is made by Easton (2006) who states:

> In light of the fact that assumptions about the terminal growth rate are unlikely to be descriptively valid, the inferences based on the estimates of the expected rate of return that are based on these assumptions may be spurious. The appeal of O'Hanlon and Steele (2000), Easton, Taylor, Shroff and Sougiannis (2002) and Easton (2004) is that they simultaneously estimate the expected rate of return and the expected rate of growth that are implied by the data. The other methods assume a growth rate and calculate the expected rate of return that is implied by the data and the assumed growth rate. Differences between the true growth rate and the assumed growth rate will lead to errors in the estimate of the expected rate of return.

For this reason, we implement a process for estimating dividends which does not depend upon an arbitrary assessment of what is reasonable. There are constraints imposed on the analysis, because there are some assumptions which, if incorporated jointly, simply do not allow us to estimate the cost of equity. For example, we cannot assume that long-term growth is greater than the cost of equity, because the value of the stock would be infinite. These constraints are detailed in the analysis.

Our estimates are also derived after assuming mean-reversion of the model inputs, rather than assuming constant growth in dividends in perpetuity from the first forecast year. But to introduce our estimation process, we first present the constant growth dividend discount model.

3.2 Constant growth dividend discount model

The simplest formation of the dividend discount model of equity valuation is the case where dividends are expected to grow at a constant rate in perpetuity. In this constant growth version of the dividend discount model, we have the following equation:

$$P = \frac{D_1}{r_e - g}$$

where P is the share price, D_1 is the expected dividend in one year, r_e is the cost of equity and g is the constant expected growth rate of dividends.

This equation can be re-arranged to derive the cost of equity as the sum of dividend yield (D_1/P) and growth (g):

$$r_e = Dividend\ yield + growth = \frac{D_1}{P} + g$$

Growth in dividends per share can come from both the reinvestment of earnings and from the issue of new shares. In the case of reinvestment of earnings, there will be positive growth in dividends per share provided those investments earn a positive return on equity. In the case of growth from the issue of new shares there will only be growth in dividends per share if the investments funded by new shares earn a return above the cost of equity.

The equation for growth from each of these two sources – reinvestment of earnings and issue of new shares – is given below. This expresses growth as a function of three inputs, the reinvestment rate (*RR*, the proportion of earnings per share retained in the firm, which can also be expressed as one minus the dividend payout ratio or *DPR*), the expected return on equity from new investments (*ROE*), the percentage increase in the number of shares (*C*), and the price/earnings ratio (P/E_1, where price is the present value of expected dividends and E_1 is next year's forecast earnings per share). The derivation of the equation is presented in Sub-section 7.1.

$$g = \frac{(1 + RR \times ROE)/(1 + C)}{1 - \frac{C}{1 + C} \times \frac{P}{E_1} \times ROE} - 1$$

For example, suppose that the reinvestment rate *(RR)* is 20%, the expected return on equity *(ROE)* is 18%, the percentage change in shares *(C)* is 1%, and the price/earnings ratio (P/E_1) is 16. The implied growth rate is 5.58%, computed as follows:

$$\begin{aligned} g &= \frac{(1 + 0.20 \times 0.18)/(1.01)}{1 - \frac{0.01}{1.01} \times 16 \times 0.18} - 1 \\ &= \frac{1.0257}{0.9715} - 1 \\ &= 5.58\% \end{aligned}$$

A very similar equation is used by regulators in the United States, so as to account for growth from the retention of earnings and the issue of new shares. This is not the only way growth is estimated by U.S. regulators but it is an equation which is analogous to the equation we use to estimate growth from both reinvestment of earnings and new share issuance. The growth component from reinvestment of earnings is computed as *br* in which *b* is the reinvestment rate and *r* is the return on reinvested earnings.

The incremental growth component from the issue of new shares is computed as the product of two factors, s and v. The first factor, s, is the fraction of common equity expected to be issued annually as new common stock. It is not simply the expected percentage change in the number of shares. In other words it is not C from the above equation. It is the amount of new equity relative to the book value of existing equity, which can also be computed as the percentage of new shares issued multiplied by the market-to-book ratio (M/B). The second factor, v, is the equity accretion rate computed as the percentage difference between the market value of shares and book value of shares ($1 - B/M$).[17]

The dividend discount model equation used in some regulatory determinations in the United States is as follows:[18]

$$\begin{aligned} r_e &= \frac{D_1}{P} + g \\ &= \frac{D_1}{P} + br + sv \\ &= \frac{D_1}{P} + RR \times ROE + \%\ increase\ in\ equity \times \left(1 - \frac{B}{M}\right) \\ &= \frac{D_1}{P} + RR \times ROE + C \times \left(\frac{M}{B} - 1\right) \end{aligned}$$

This equation has similar inputs to the equation we derived, and will have exactly the same inputs if we assume that the return on equity on new investments is equal to the current return on equity. Under this assumption, M/B is replaced by $P/E \times ROE$. But the form of the equation is a little different and we do not know how this equation is derived. We derived our own equation and verified that this equation does, in fact, lead to constant growth in dividends per share. The equation presented immediately above leads to growth estimates which are slightly below the equation we derived.

Incorporating this equation for growth into the dividend discount model we have the equation presented below:

$$r_e = \frac{D_1}{P} + g = \frac{D_1}{P} + \frac{(1 + RR \times ROE)/(1 + C)}{1 - \frac{C}{1+C} \times \frac{P}{E_1} \times ROE} - 1$$

The problem with implementing a constant growth version of the dividend discount model is that, either at the firm or market level, there is a range of differing assumptions which may be used to populate the above equation. We can certainly populate this equation with long-term average inputs for the market, but that does not provide us with an estimate of the prevailing cost of equity. It is also crucial to not populate this equation with a contemporaneous estimate of the dividend yield and long-term inputs to the growth term. The share price will reflect expectations for all future dividends. So a high share price/low dividend yield could reflect expectations for high growth in those dividends, and a low share price/high dividend yield could reflect expectations for low growth in those dividends. If we add a constant expectation of long-term growth to the dividend yield, we would implicitly assume that the share price tells us nothing about future dividend growth.

[17] Our explanation of the U.S. regulatory version of the dividend discount model is taken from expert evidence presented in Seminole Electric Cooperative, Inc. and Florida Municipal Power Agency, Complainants v. Florida Power Corporation, Respondent. See pages 7 to 15 of the transcript and Exhibit JC-2 for computations of the cost of capital based upon a set of comparable firms.

[18] Note that in the United States D_1 is generally computed as $D_0 \times (1 + 0.5g)$ because this is approximately equivalent in present value terms to D_1 when dividends are paid quarterly. For ease of exposition we simply refer to this as D_1.

3.3 Accounting for mean-reversion in parameter inputs

3.3.1 General mean-reversion approach

The challenge in measuring the cost of equity using the dividend discount model is to allow dividend growth to be determined by the data, and not by an arbitrary choice of the analyst. Growth is determined by four inputs – reinvestment rate *(RR),* return on equity *(ROE),* the percentage of new shares issued *(C)* and the price/earnings ratio *(P/E₁)*.

In the mean-reversion case, we allow the reinvestment rate and return on equity to revert to estimates of long-term values over ten years. The ten year period comprises two years of explicit analyst forecasts and eight years of reversion to long-term estimates. So the current *ROE* reverts in equal amounts to a long-term value and the current reinvestment rate reverts to a long-term value, determined by the long-term growth rate. To account for new share issuance, we take the percentage change in shares on issue *(C),* and re-estimate the reinvestment rate *as if* growth was funded from reinvestment of earnings rather than new shares. So for example, if earnings per share was \$1.00 and dividends per share was \$0.80, the reinvestment rate is 20%. If the firm issued 1% of new shares, we estimate the growth rate and then ask, "What reinvestment rate would give the same growth if all growth was funded from reinvestment?"

To show this for a specific example, suppose that the price/earnings ratio *(P/E₁)* is 16 and the return on equity *(ROE)* is 18%. In a previous section we demonstrated that these inputs implied a growth rate of 5.58%, according to the following equation:

$$\begin{aligned} g &= \frac{(1+RR\times ROE)/(1+C)}{1-\frac{C}{1+C}\times\frac{P}{E_1}\times ROE} - \\ &= \frac{(1+0.20\times 0.18)/(1.01)}{1-\frac{0.01}{1.01}\times 16\times 0.18} - 1 \\ &= \frac{1.0257}{0.9715} - 1 \\ &= 5.58\% \end{aligned}$$

What we want to know is, to maintain the same growth rate of 5.58% without issuing new shares but instead paying less dividends, what would the reinvestment rate need to be? The reinvestment rate would need to increase to 31%, computed as follows:

$$\begin{aligned} g &= RR\times ROE \\ RR &= \frac{g}{ROE} = \frac{0.0558}{0.1800} = 31.03\% \end{aligned}$$

Note that we have not specified what the values are for long-term growth, the reinvestment rate or the return on equity. These will be determined by the data, according to which set of inputs provide the smoothest transition to long-term growth, and which set the present value of expected dividends equal to the price target. This process is described below.

3.3.2 Mean-reversion specifics and comparison with Bloomberg approach

In outlining our process it is useful to compare our estimation technique with that of Bloomberg. Bloomberg has two stages of growth prior to reaching this perpetual growth state, and the length of these stages is contingent upon whether the security is classified as having low, average, high or explosive growth. Ultimately, however, the assumption made by Bloomberg incorporated into the terminal value is that returns on reinvested earnings equal their cost of equity.

This means that Bloomberg solves the problem of simultaneously estimating g and r_e by assuming that, in the terminal state, $g = RR \times r_e$. This is the crucial assumption adopted by Bloomberg to allow it to estimate the cost of equity for each firm in the market, and for the market risk premium as a market capitalisation-weighted average for all firms.[19]

The process by which we project dividends and then simultaneously estimate g and r_e is different on two fronts. The first difference is that we jointly estimate a set of three parameters (long-term growth, cost of equity and long-term return on equity). In contrast, Bloomberg imposes the assumption that the long-term payout ratio is 45% and that long-term returns on equity equal the cost of equity.[20] The second difference is that we rely upon individual analyst earnings and dividend forecasts and individual analyst price targets, made on approximately the same date. Bloomberg considers average analyst earnings and dividend forecasts and share prices each day, which induces volatility in the estimated cost of equity due to share prices incorporating more timely information than analyst forecasts.

In our technique, we consider 2,672 possible combinations of the cost of equity, long-term growth and return on equity. The cost of equity takes on a range of 4% to 20%, long-term *ROE* takes on a range of 3% to 30% (and which cannot be more than 1% below the cost of equity) and long-term growth takes on a range of 1% to 10% (and which must be less than the cost of equity). We measure *ROE* according to earnings per share forecasts in year two and book value of equity at the end of year one, and then assume that this return on equity changes incrementally in equal amounts to the long-term *ROE* estimate. The dividend payout ratio also changes incrementally in equal amounts to the long-term dividend payout ratio, which is equal to $1 – g \div ROE$.

From all combinations of r_e, g and *ROE* this allows us to compute 2,672 valuations for each analyst price target, earnings and dividend forecast on each stock. To decide upon the combination of inputs which best fits the data we require that combination to provide a valuation close to the analyst's price target and to provide a smooth transition from near-term growth to long-term growth. First, we take all the cases in which the valuation is within 1% of the price target. We then want to know which combination of inputs provides the best fit, or in other words, which is most likely to represent the dividend projections and discount rate incorporated into the valuation. Our criteria is to compare the earnings growth rate in year 10 with the long-term growth rate. We select the case in which the ratio of

[19] Note that the cost of equity estimates that Bloomberg reports for individual firms are a combination of dividend discount model estimation and a Capital Asset Pricing Model (CAPM) estimate. Bloomberg compiles individual firm cost of equity estimates, takes a market capitalisation-weighted average of these estimates to determine the market-wide cost of equity and market risk premium, and then applies its estimate of firm-specific beta to determine each firm's cost of equity estimate.

[20] It is generally-accepted in the accounting literature that accounting standards are conservative, in that accounting earnings and balance sheet values have more chance of being understated than overstated (Cheng, 2005; Easton, 2006). So whether return on equity (NPAT/Equity) has more chance of being overstated or understated depends upon whether those conservative accounting assumptions have a relatively greater impact on the income statement or the balance sheet. This means that we can observe return on equity which exceeds the cost of equity even if, in economic substance, economic rents are zero. In relation to conservative accounting assumptions, Cheng cites the example of research and development expenditure being expensed, even though this expenditure is expected to generate future economic benefits. In relation to economic rents, Cheng states that the absence of perfect competition can mean that some firms can set prices above their marginal costs and generate abnormal earnings. The key points are (1) we do observe return on equity in historical data which exceeds the cost of equity, (2) there are reasons why we would not necessarily expect the return on equity and the cost of equity to converge, and (3) we are able to estimate the cost of equity without imposing the assumption that it equals the return on equity. The assumption that long-term returns on investment equal the cost of equity is also invoked by Li, Ng and Swaminathan (2013), who implement this assumption after a 15-year forecast horizon. The typical price/earnings ratio in their sample is around 14 and, as we discuss later, if returns equal the cost of equity the long-term price/earnings ratio will be the inverse of the cost of equity. So under most cost of equity estimates price/earnings ratios will decline to single digits. An initial price/earnings ratio of 14 and a long-term price/earnings ratio below 10 is only possible with very high dividends and earnings growth initially, falling rapidly to long-term growth.

year 10 growth to long-term growth is closest to one, and this provides us with our best estimate of the cost of equity, long-term growth and long-term return on equity.[21]

In implementing this process we impose an upper bound on the initial return on equity such that the growth in earnings per share cannot change from positive to negative over the ten years prior to constant long-term growth. For example, if the initial *ROE* is very high we can have a case where growth is 50% initially, then declines to –10% by year 10, and then increases to 5% in the long-term. We ensure that the initial return on equity is sufficiently low that growth does not change from positive to negative and then back again.

In the table below we summarise the differences between the computation of our cost of equity estimates and those of Bloomberg. There are two fundamental differences. First, Bloomberg makes the assumption that long-term growth is equal to the product of a long-term reinvestment rate of 55% and the cost of equity. In other words, Bloomberg assumes that investments are expected to earn a return equal to the cost of equity in the mature stage. In contrast, we transition to a variety of long-term growth rates and *ROE* assumptions, and select the cost of equity/growth/*ROE* combination which provides a valuation close to the price target and for which the ratio of year 10 growth to long-term growth is closest to one. Second, we rely upon individual analyst inputs and contemporaneous price targets (and then take an average of cost of equity estimates) while Bloomberg relies upon average analyst inputs.

3.3.3 Numerical example

A numerical example illustrates our process. The equation below is the dividend discount model, with a ten-year explicit forecast period, followed by a period of constant growth. This equation states that the price *(P)* is equal to the present value of expected dividends *(D)* discounted at the cost of equity (r_e).[22]

$$P = \frac{D_1}{(1+r_e)^1} + \cdots + \frac{D_{10}}{(1+r_e)^{10}} + \frac{D_{10} \times (1+g)}{(r_e - g) \times (1+r_e)^{10}} = \sum_{t=1}^{10} \frac{D_t}{(1+r_e)^t} + \frac{D_{10} \times (1+g)}{(r_e - g)(1+r_e)^{10}}$$

To populate this equation we set price equal to the analyst's price target, and D_1 and D_2 equal to the year one and year two dividend forecast. In cases in which there is no dividend forecast provided, we use the last actual dividend payout ratio multiplied by the earnings forecast for years one and two. To project dividends over the next eight years, we project return on equity, earnings per share and the dividend payout ratio.

[21] The process by which we project earnings and dividends over a 10 year forecast horizon and then into perpetuity is presented in more detail in Fitzgerald, Gray, Hall and Jeyaraj (2013). There are two differences between the method presented in that paper and the one applied here. First, in the current analysis we incrementally adjust the year two dividend payout ratio to the long-term dividend payout ratio. In the academic paper we maintain a constant dividend payout ratio over the first 10 years and then shift in one step to the long-term dividend payout ratio. Second, in the current analysis we determine the best estimates according to the ratio of year 10 growth in earnings compared to long-term growth in earnings. The ratio closest to one implies the smoothest transition of growth over time. In the academic paper we assume that all analysts covering the stock incorporate the same cost of equity, long-term growth rate and long-term *ROE* and measure which combination generates the lowest dispersion of valuations relative to price targets. This assumption leads to estimation error because the analyst price targets exhibit too much dispersion for it to be reasonable to assume they all have the same long-term inputs. Other published papers make the even more tenuous assumption that all firms in the same industry have the same long-term expectations.

[22] In this equation the cost of equity is held constant over the life of the expected cash flows, so is conceptually equivalent to the yield to maturity on debt. So our estimate of the cost of equity is in no sense a short-term estimate of the cost of equity.

Table 1. Comparison between SFG and Bloomberg estimates of the cost of equity

	SFG	Bloomberg
Time period prior to constant/mature growth	10 years	19 years
What is the *ROE* at maturity?	3% to 30%	r_e
What is the dividend payout ratio at maturity?	$1 - g \div ROE$	45%
What is the constant growth rate at maturity?	1% to 10%	$(1 - DPR) \times r_e$
How to transition to long-term growth?	Explicit forecasts of dividends and earnings in years 1 and 2.	Explicit forecasts of dividends and earnings in years 1 and 2.
	ROE in year 2 reverts to long-term *ROE* over remaining 8 years.	"Growth" stage of either 3, 5, 7 or 9 years.
	DPR in year 2 reverts to long-term *DPR* over remaining 8 years.	"Transition" stage of either 14, 12, 10 or 8 years.
	Reversion is in equal increments.	Length of stages contingent upon Bloomberg's classification of the firm into explosive, high, average or slow growth. This classification is based upon the distribution of growth rates for all firms.
		Growth rate during "growth" stage is analyst's average estimate of long-term growth.
		Reversion in equal increments to mature growth rate over transition stage.
Data	Individual analyst inputs for each firm over a six month period. Earnings and dividend expectations matched with price target.	On each date, average values computed for all outstanding analyst inputs available at that date. Earnings and dividend expectations matched with share price.

To illustrate, suppose that D_1 and D_2 are \$0.16 and \$0.18, respectively, and E_1 and E_2 are \$0.25 and \$0.30. Also suppose that the book value per share at time zero (B_0) is \$1.60. This means that forecast *ROE* in year one is 15.63% ($E_1 \div B_0$ = \$0.25 ÷ \$1.60 = 15.63%). The book value per share at the end of year one is equal to \$1.69 ($B_1 = B_0 + E_1 - D_1$ = \$1.60 + \$0.25 – \$0.16 = \$1.69). This means that the return on equity in year two is 17.75% ($E_2 \div B_1$ = \$0.30 ÷ \$1.69 = 17.75%).

These initial values form the starting point for our projections over the next eight years. In forming these projections we incorporate a large number of combinations of r_e, g and *ROE* (2,672 combinations in total) and perform valuations. *ROE* reverts in equal increments from an initial value to a long-term value, and the dividend payout ratio also reverts in equal increments to its long-term value. The long-term dividend payout ratio is equal to $1 - g \div ROE$.

One combination would be growth of 6%, cost of equity of 10% and return on equity of 15%. Long-term *ROE* of 15% and growth of 6% implies a long-term dividend payout ratio of 60% (that is, 1 – 0.06/0.15 = 0.60). To estimate the initial dividend payout ratio we take an average of the payout ratio for the first two years, which is 62.00% in this case ($D_1 \div E_1$ = \$0.16 ÷ \$0.25 = 0.64; and $D_2 \div E_2$ =

\$0.18 ÷ \$0.30 = 0.620). To estimate the initial *ROE* we also take an average of the estimates over two years, which in this example is 16.69% ($E_1 \div B_0$ = \$0.25 ÷ \$1.60 = 15.63%; and $E_2 \div B_1$ = \$0.30 ÷ \$1.69 = 17.75%). This means that each year over the next eight years, the return on equity falls by 0.21% until it reaches the long-term value of 15.00%, and the dividend payout ratio falls by 0.25% until it reaches the long-term value of 60.00%. This allows us to project, every year, earnings per share, dividends per share and book value per share.

Incorporating the assumptions of 6% growth, 10% cost of equity and 15% return on equity results in a valuation of \$3.75 per share. This is 6.13% below the price target of \$4.00 so is not an acceptable combination of inputs. We consider an unbiased valuation to be within 1% of the price target. We compile all the combinations of inputs which lead to unbiased valuations. The final step is to select the combinations in which the growth of earnings per share in year 10, relative to the long-term growth, is smallest in percentage terms.

To complete the example, if we use inputs of 8% for long-term growth, 12% for the cost of equity and 19% for return on equity, the valuation is \$4.04 (within 1% of the price target) and year 10 growth in earnings per share is 9.45%. Compared to long-term growth of 8.00% this is a difference of 18.09% (that is, 0.0945 ÷ 0.0800 = 18.09%). This provides us with an estimate of the cost of equity of 12%.[23]

One implication of Bloomberg matching average analyst earnings and dividend forecasts with the share price is that it leads to an overstatement in variation of the cost of equity. Share prices incorporate new information in a timely manner, while changes in analyst forecasts incorporate new information with a lag. Some analysts will make many changes to earnings forecasts in a timely manner, while other analysts will make fewer changes over time. For an individual analyst, the longer the time period between the receipt of new information and revisions to earnings forecasts, the less relevant will be the analyst's forecasts. This means that the average earnings and dividend forecasts for an individual firm at a point in time will incorporate less timely information than the share price.

This results in an overstatement of the variation in cost of equity estimates over time. When new information is received by the market, resulting in a share price change, this could reflect revisions to expectations for dividends and earnings, revisions to the cost of equity, or both. Because analysts do not restate their earnings and dividend forecasts at every instant in time, the average analyst forecasts will always include some amount of information relevant to a prior period. In short, changes in the average analyst earnings and dividend forecast over time are smoother than changes in share prices, so the variation in the cost of equity estimates over time will be overstated. This problem is not a feature of our analysis because we rely upon individual analyst forecasts of earnings, dividends and price targets made at approximately the same point in time.[24]

Our dataset (which is discussed in detail in the next section of this report) comprises 41,362 sets of analyst forecasts and there is a cost of equity estimate derived for each set of analyst forecasts. Once these cost of equity estimates are compiled, we take an average of the cost of equity estimates for each firm every six months.

[23] An even more precise estimate of the cost of equity could be obtained if all possible values were considered rather than only considering even percentages of the cost of equity, such as 10%, 11% and so on. But in large samples this increase in precision for an individual data point would make no difference to our final conclusions, which are based upon thousands of data points, whilst the increase in computational requirements would be substantial.

[24] We allow for a difference of up to 28 days between the input of the earnings and dividend forecast and the input of the price target, but the majority of earnings, dividend and price target forecasts in our data are entered on the same day. This is why we say the forecasts are made at approximately the same point in time.

3.3.4 Specifics relating to estimation of inputs

We estimated each of the inputs to the dividend discount model in the following manner.

- Dividend yield (D_1/P) is the average of dividend per share forecasts in years one and two, divided by the price target. The reason we use the average dividend over two forecast years is to mitigate estimation error, because this average is more likely to represent the current income distribution of the firm, compared to either the first or second year forecast. Essentially we treat the first two forecast years as the current state of play. The reason we use the analyst's price target rather than the share price, is because the earnings and dividend forecasts could reflect a degree of optimism or pessimism compared to what is incorporated into the share price. But it is reasonable to assume that, whatever is the optimism or pessimism reflected in earnings and dividend forecasts is also reflected in the analyst's price target.[25]

- The initial return on equity (*ROE*) is the average return on equity (earnings per share/book value per share) over the first two forecast years. As with the dividend yield, the use of average return on equity over two years is to mitigate estimation error. The two year period represents the current state of play.

- The initial reinvestment rate (*RR*) is first estimated as one minus the average of the dividend payout ratio (dividends per share/earnings per share) over forecast years one and two. This is then re-estimated after taking account of new share issuance. As mentioned above, we estimate what the reinvestment rate would be if we used the same initial growth (which accounts for new share issuance) but if that growth was achieved entirely by the reinvestment of earnings.

- The price/earnings ratio (P/E) is the price target divided by the average earnings per share over the first two forecast years.

- The percentage change in shares on issue (*C*) is computed as double the percentage change in shares on issue computed over the prior six months, because it needs to be estimated as an annualised rate of change in shares on issue.

We then imposed constraints on the inputs to exclude unreasonable cases. As mentioned above, it is important to minimise subjective judgement of the researcher in the application of this technique, because subjective judgement can be used to justify a wide range of inputs and lead to an equally wide range of cost of equity estimates. But there are some cases in which the model simply cannot accommodate the inputs because they cannot mathematically allow for our framework in which the firm eventually reaches a constant growth state. The constraints are as follows.

- The price/earnings ratio cannot be negative in a constant growth state, because eventually the firm will liquidate. This also means that the return on equity cannot be negative. In our dataset 2% of

[25] There are studies which report that analyst earnings expectations are optimistic. But these conclusions are generally based upon the average difference between the analyst earnings per share forecast and the actual earnings. On average forecasts are above the actual earnings, but in general the median forecasts are close to actual results. The reason for this difference is probably to do with the causes of earnings surprise. The analyst forecast represents the analyst's best guess as to what the earnings per share will be, not the average outcome from all possible events. And there is more chance of an event, such as an asset write-down, which causes earnings to be well below projections, than an event which causes earnings to be well above projections. So in the median case, the analyst forecast is about right because half the time things turn out better than expected and half the time things turn out worse than expected. But the average forecasts appears optimistic, because there are some occasions when things turn out much worse than expected, but fewer occasions when things turn out much better than expected. What this means is that analyst projections are not, in general optimistic. But for our purposes it does not matter if they are optimistic or pessimistic, provided the same optimism or pessimism is reflected in the price target. In our dataset the median and average difference between the average analyst earnings per share forecasts and actual earnings per share are less than 1% of share price. On a two-year basis, the median and average difference between the average analyst per share forecast relative to actual earnings forecast is less than 2% of share price.

observations comprised firms with earnings per share forecasts which were negative over two forecast years. So we winsorize the sample with respect to this input at the 2nd and 98th percentile. This means that, for all observations below the 2nd percentile, we replace those inputs with the 2nd percentile, and for all observations above the 98th percentile, we replace those inputs with the 98th percentile. This does not mean we lose observations from the dataset. It just means that, for the particular variable being measured (in this case the price/earnings ratio is the variable being measured), it is replaced with the 2nd or 98th percentile.

The reason we winsorize the dataset at the lower and upper end of the distribution is because we do not want to bias the results by excluding cases in which the firm had very low profits (that is, loss-making firms) but retaining cases in which the firm had very high profits. In the mean-reversion case, firms incurring initial losses can be accommodated, because by the time they reach a constant growth state the earnings will be expected to be positive. But we wanted to ensure that we begin with initial positive earnings per share in order to ensure that our results are not affected by the infrequent case of loss-making firms.

- We also require dividends to be positive. Initial dividends of zero can theoretically be accommodated, because dividends will be positive by the time the firm reaches a constant growth state. But, again, we want to avoid the case in which dividends are zero for an extended period and then increase sharply in the constant growth state. In our sample, dividends of zero are infrequent, covering just 1% of the sample. So we winsorize the dividend yield and the dividend payout ratio at the 1st and 99th percentiles.

- Finally, we consider the growth from new share issuance and impose two constraints.

First, we impose the constraint that the total growth in earnings per share and dividends per share *(g)* cannot be more than what it would be if there was 100% reinvestment of earnings and no new share issuance. Cases in which a mature firm is growing so fast that it reinvests all of its earnings back in the firm and raises further capital from new share issuance represent major transformational changes for the firm. So we constrain the growth in new share issuance so that total growth cannot exceed *ROE*.

Second, we do not allow the number of shares to decrease so we constrain growth in new share issuance to be at least zero. In 10% of cases the percentage change in the number of shares over six months was less than zero. So we winsorized the growth in new share issuance at the 10th and 90th percentiles. As with the return on equity, the reason we winsorize the dataset at the low end and the high end is because there are some cases in which growth in shares is unusually low, and some cases in which growth of shares is unusually high. If we only constrain the cases in which growth in shares is negative then we will overstate growth from new share issuance.

4. Results

4.1 Data

For Australian-listed firms we compiled individual analyst forecasts of earnings per share, dividends per share and price targets over the 11 year period from 1 July 2002 to 13 June 2013[26] from the Institutional Brokers' Estimate System ("IBES"). We then grouped the sample into six monthly intervals according to the announcement date of the year one earnings per share forecast. An individual analyst can have more than one input during the six month period. So if a stock was covered by two analysts, and the first analyst submitted one forecast and the second analyst submitted two forecasts, we compile three estimates of the cost of equity for that firm during the six month period.

The total number of analyst inputs in the IBES dataset which had sufficient data available for analysis was 42,366. This means that over the 11 year period there were over 42,000 combinations of earnings per share expectations, dividends per share expectations and price targets for Australian-listed firms with all other data available for analysis. We partitioned the sample into six month intervals so we have a large number of firms and analyst inputs available in every six month period. An individual analyst can make more than one input for each firm in a six month period. For each of the 42,366 observations we estimate the cost of equity, and average these estimates across all analyst inputs for each firm every six months.

This allows us to compile a sample of 4,835 estimates of firm cost of equity estimates. On average, each time a firm appears in a six month period, there are 8.8 cost of equity estimates for that firm. There are also 579 individual firms in the dataset which means that, on average, each firm appears in the dataset 8.4 times over the 11 year period. There were 31 firms that appeared in the sample in all 22 half-year periods. Firms that appear in the dataset more frequently have larger market capitalisation than other firms, but there is no material difference in their book to market ratios.

Across the 4,835 sample firm/half-years[27], we have the following average values – dividend yield of 4.6%, price/earnings ratio of 17.9[28], initial return on equity of 17.3% and change in shares on issue of 1.7%. Also note that, on average, analyst price targets are 14% higher than share prices. So if we were to use share prices in our analysis, the cost of equity estimates would be higher than we present here.

4.2 Estimates

4.2.1 Parameters estimated

There are four key parameters estimated for each individual firm, which we aggregate according to market capitalisation to generate parameter estimates for the broader market. These parameters are the cost of equity, long-term growth, long-term return on equity and the dividend yield. The dividend yield which appears in the following tables is simply the average dividend relative to price target over the first two years, so is reasonably self-explanatory. It is not the long-term dividend yield.

The cost of equity is the discount rate which sets the present value of expected dividends equal to the analyst's price target. It is a constant discount rate over all forecast years so is analogous to the estimate of the yield to maturity on corporate bonds used to estimate the cost of debt in setting regulated

[26] At the time of writing this is the most recent date for which data is available.

[27] The term "firm/half-year" refers to an estimate for a firm during a particular half-year. The sample of 4,835 observations incorporates only one average cost of equity estimate for a firm in a given half year, but that firm can appear in many half-years. So for example if a firm appears in 10 half-year periods there are 10 "firm/half-year" observations.

[28] These dividend yield values and price/earnings ratios are based upon price targets. If we compute the price/earnings ratio on the basis of the share price, rather than the price target, the average price/earnings ratio is 16.0 and the average dividend yield is 5.1%.

returns. It is worth reiterating that, as price targets on average exceed share prices, our estimates of the cost of equity are lower than if we had used share prices in the analysis. The reason we use price targets is because each analyst will have made forecasts of earnings, dividends and price using a consistent framework. If an analyst is relatively optimistic or pessimistic with respect to future earnings, we would also expect that analyst to be optimistic or pessimistic with respect to his or her price target. If we were to match earnings forecasts with share prices we would be matching the analyst's optimism or pessimism with respect to earnings with the market's view on price.

The long-term growth rate is the constant annual growth we would expect in earnings per share and dividends per share after the 10-year explicit forecast period. We incorporate a constant reinvestment rate so this is also the expected annual growth in the share price in the terminal state. The reinvestment rate is the proportion of earnings reinvested in the firm, which we can also express as one minus the dividend payout ratio ($RR = 1 - DPR$).

The long-term return on equity *(ROE)* is the return we would expect on reinvested earnings in the terminal growth state. It is not the same as the cost of equity because we do not impose the assumption that returns must equal the cost of capital in the constant growth state. This is discussed at length in subsequent analysis. It is convenient for researchers and Bloomberg to make the assumption that $r_e = ROE$. However, if this assumption is imposed on the analysis it generates results that are inconsistent with the data. As shown subsequently, it leads to long-term price/earnings ratios in the single digits which is not what we observe for even the most mature firms in the market. The relationship between long-term growth, return on equity and the reinvestment rate can be expressed as $g = RR \times ROE$.

4.2.2 Individual firms

Our objective is to estimate the cost of equity for the market, as a market capitalisation-weighted average of individual firm estimates. But to demonstrate our process we want to summarise the dispersion of estimates across individual firms, in order to establish that these estimates can form the basis for a market expected cost of equity. Regulators have, in part, been hesitant to adopt dividend discount model estimates of the cost of equity, due to concerns over reliability. If we examine the estimates across individual firms we can verify that the dispersion of estimates is considerably lower than observed under the current implementation of the Sharpe-Linter Capital Asset Pricing Model (CAPM), namely using regression analysis of historical stock returns to estimate beta.

To begin, recall that there are 42,366 individual cost of equity estimates, which correspond to each set of analyst forecasts in the dataset. Then for each firm in each six month period we take an average of these cost of equity estimates. This dataset comprises 4,835 observations. Across these individual cost of equity estimates, the average cost of equity excluding imputation benefits is 10.8%, the average estimate of long-term growth is 5.8%, the average estimate of long-term return on equity is 18.0% and the average dividend yield is 4.6%. The distribution of these estimates is summarised in Table 2.

As mentioned above the average initial return on equity in this process was 17.3%, so the long-term return on equity is close to the average initial value. Firms with high initial *ROE* experience a decline in *ROE* and firms with low initial *ROE* experience an increase in returns on investment. But *ROE* does not need to revert to the cost of equity.

Table 2. Estimates across firm/half-years (%)

				Percentiles					
	N	Mean	StDev	5th	25th	Median	75th	95th
Cost of equity excl imp ben	4835	10.8	2.4	6.0	9.5	10.9	12.1	14.6
Long-term growth		5.8	2.2	1.7	4.6	6.1	7.3	9.3
Long-term return on equity		18.0	5.7	10.4	13.3	17.0	22.9	28.0
Dividend yield		4.6	2.0	1.4	3.2	4.4	5.8	8.2

The unit of analysis in this table is a firm/half-year, which means that a firm appears in a half-year period just once and if that firm appears in, say, 10 half-year periods, there are 10 "firm/half-year" observations.

An important issue is whether the variation in the estimates across firms is sufficiently low for them to be relied upon in estimating the cost of equity. Variation in the estimates will occur both because there truly are differences in the cost of equity across firms and because of estimation error.[29] Across all firm/half-years the standard deviation of the cost of equity estimates is 2.4%. The dispersion of outcomes is lower if we first compute an average cost of equity for each of the 579 firms.[30] In this instance the standard deviation of the estimates is only 2.0%. This occurs because estimation error in different six month periods for the same firm is cancelled out. The dispersion of firm-level cost of equity estimates is illustrated in Figure 1. Across 579 firms, 84% of cost of equity estimates lie within the range of 9% to 13%.

As a benchmark we can compare the variation in the estimates from this technique to what we would observe under the Sharpe-Lintner CAPM, if implemented in the manner currently used by the AER. At each point in time the AER applies an estimate of the market risk premium (most recently 6%) to an estimate of beta and an input for the risk-free rate.[31] In estimating beta the only quantitative analysis used is the regression of stock returns on market returns. Under this estimation technique the beta estimates across all firms from this technique typically have a standard deviation in the range of about 0.6 to 0.8 depending upon the sample. So the standard deviation of the cost of equity estimate across all firms, from the current approach, would be in the range of 3.6% to 4.8%. And this standard deviation does not account for estimation error in the market risk premium. If we accounted for imprecision in the market risk premium input in the CAPM, the dispersion of cost of equity estimates would be even wider.

In the figure below we illustrate the dispersion of cost of equity estimates that would occur if beta estimates were normally distributed with a mean of 1.0 and standard deviation of 0.6.[32] This dispersion of beta estimates would result in just 46% of cost of equity estimates falling within the range of 9% to 13%, compared to 84% under the dividend discount model analysis.

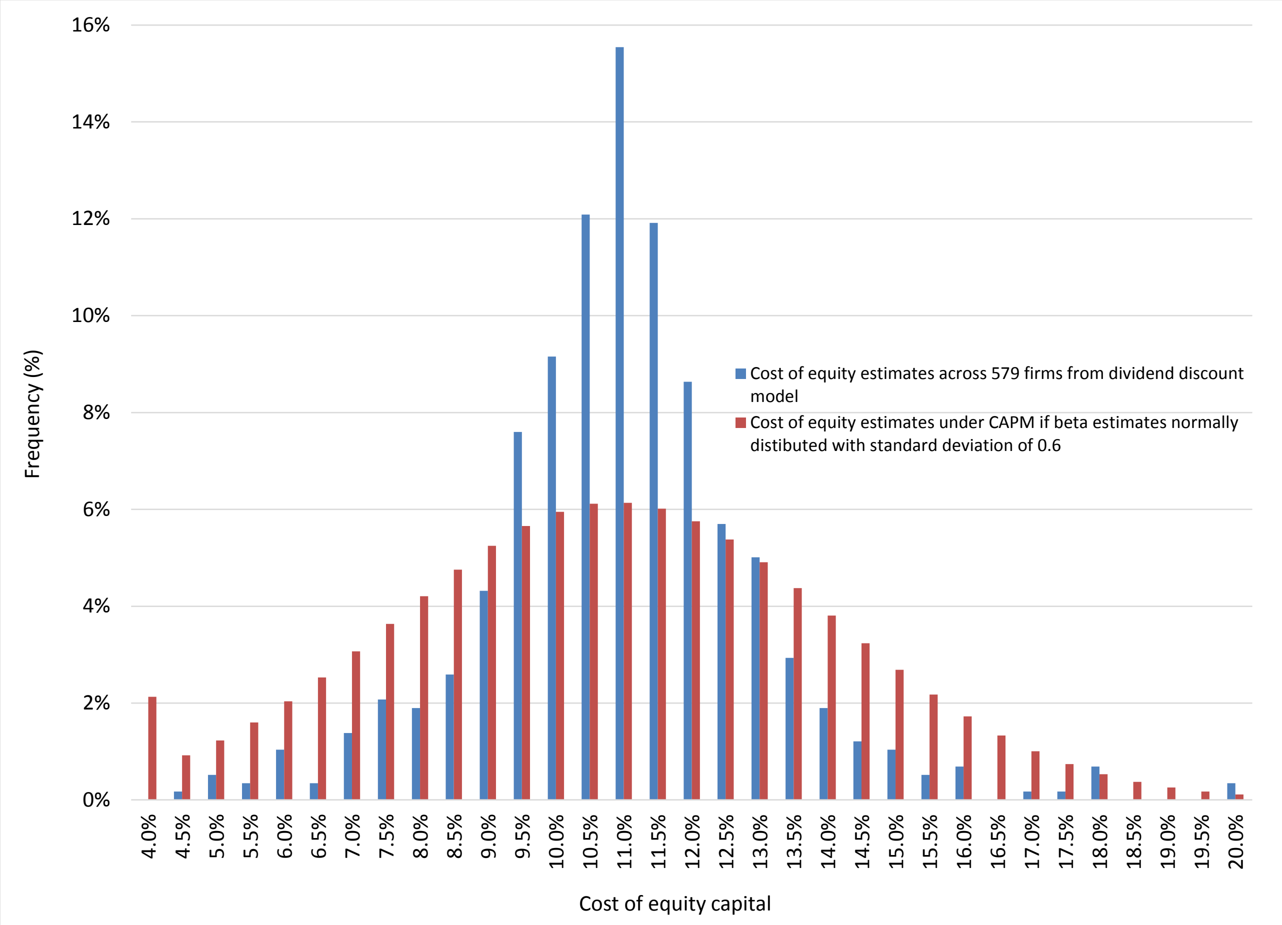
[29] This is the case for any technique for estimating the cost of equity, including the CAPM.

[30] This is an alternative way to estimate the cost of equity over the sample period for the average firm. In this calculation each firm carries equal weight in the calculation. In the figures presented in Table 2 each firm/half-year carries equal weight.

[31] In this discussion the impact of imputation is ignored because the purpose is merely to illustrate the substantially larger dispersion of cost of equity estimates derived from the AER's prior implementation of the Sharpe-Lintner CAPM, whereby beta estimates are derived from regression analysis of stock returns on market returns. The mean assumption is that the cost of equity is equal to the risk free rate of 5.2% and a market risk premium of 6.0%, ignoring imputation. The sum of these values, 11.2%, is the cost of equity under regulation, and the cost of equity excluding imputation benefits is 10.1% ($0.112 \times 0.9032 = 10.1\%$). A firm with a beta estimate of 0.4, one standard deviation below the mean, would have a cost of equity under regulation of 7.6%, computed as $0.052 + 0.4 \times 0.060 = 0.076$. That same firm would have a cost of equity excluding imputation benefits of 6.9% ($0.076 \times 0.9032 = 6.9\%$). A firm with a beta estimate of 1.6, one standard deviation above the mean, would have a cost of equity under regulation of 14.8% and a cost of equity excluding imputation benefits of 13.4%. So the average firm would have a cost of equity excluding imputation benefits of 10.1% and the range of outcomes one standard deviation either side of the mean is 6.9% to 13.4%.

[32] The reported cost of equity figures in the chart use the same average risk-free rate (5.2%) and same average market risk premium (5.4%) as implied by the cost of equity estimates from our dividend discount model analysis. These inputs are discussed in a later sub-section of the report.

Figure 1. Dispersion of cost of equity estimates across firms



The estimates of the cost of equity for individual firms exclude any benefits from imputation credits. The estimates derived from CAPM assumptions result from assuming that beta estimates are normally distributed with mean zero, standard deviation of one, a risk free rate of 5.2% and a market risk premium of 6.0%, also without consideration of imputation credits. See the text for detailed discussion of this issue.

So while there are some high and low values for the estimated cost of equity (10% of outcomes are either below 6.0% or above 14.6%), we observe even more extreme outcomes under the application of the CAPM, if the beta estimate is derived only from regression analysis of stock returns. Ideally there would be less dispersion in the cost of equity estimates, so the only variation represents true differences in risk across firms. But if we are to implement a process which applies to all firms, and not select individual inputs for each firm, there will be some noise in this process. The important point is that the data suggests there is less noise in our estimates than in those derived from the current approach. Importantly, as with any cost of capital estimation technique, we should refer to portfolio of firms in reaching conclusions rather than rely upon the cost of capital estimate from any individual firm.

In Table 3 we report mean values across industry sectors for the estimated cost of equity, long-term growth, long-term return on equity and dividend yield. The industry sectors are those reported by IBES. Across the sectors the average estimate for the return on equity ranges from 9.8% for Health care to 11.6% for Transportation. Average long-term growth rates range from 5.2% to 6.9% and the average long-term return on equity ranges from 15.8% to 21.0%.[33]

[33] The average long-term return on equity estimates are consistent with the return on equity estimates from forecast years one and two, and with return on equity estimates derived from historical earnings only. Based upon the first two years forecast earnings, the mean and median return on equity values across the sample are 24.2% and 16.5%, respectively. Based upon actual earnings, the mean and median return on equity values are 30.0% and 15.5%, respectively.

Table 3. Industry cost of equity estimates (%)

	N	Cost of equity excl imp benefits	Long-term growth	Return on equity	Dividend yield
Basic industries	781	11.3	5.9	17.9	3.6
Capital goods	537	11.5	5.8	18.1	4.3
Consumer durables	196	11.0	5.6	20.4	5.6
Consumer non-durables	333	10.4	5.8	18.0	4.5
Consumer services	784	10.2	5.5	19.0	4.7
Energy	271	10.4	6.0	17.0	3.6
Finance	1232	10.7	6.2	16.7	5.4
Health care	192	9.8	6.0	18.2	3.5
Public utilities	108	10.7	5.5	20.6	5.3
Technology	288	10.5	5.2	21.0	4.6
Transportation	113	11.6	6.9	15.8	3.5
All firms	4835	10.8	5.8	18.0	4.6

4.2.3 Market

In this section we turn our attention to the Australian market as a whole. The expected return on the market is a market capitalisation-weighted average of the expected return on each stock. We compiled this estimate every six months and report our results in Table 4. Results are also illustrated in Figure 2. The table shows that the average expected return on the market over this period was 10.6%. This can be compared to the 5.2% average yield on 10 year government bonds to form an estimate of the market risk premium over this period. The average market risk premium over this period is estimated at 5.4%.[34]

The global financial crisis began to materially impact asset prices in the second half of 2008, following which we observed substantial increases in corporate debt yields and decreases in the yield on government bonds. In our sample we also observe an increase in the estimated market cost of equity during this period. From 2H02 to 1H08 the average cost of equity excluding imputation benefits for the market was 10.3%, which increased to an average 10.9% from 2H08 to 1H13. In comparison to a declining risk-free rate, the estimated market risk premium rose from an average 4.7% to 6.2%. In the last six months of the sample the market risk premium is estimated at 6.8%. This is the most recent data in the sample so our estimate of the prevailing market cost of equity excluding imputation benefits is 10.2% and the implied market risk premium excluding imputation benefits is 6.8%.

The estimates provided by Bloomberg provide a point of comparison. Bloomberg estimates are only available from the second half of 2008 onwards. On average the expected return on the market from Bloomberg is 13.4% from 2H08 to 1H13 (compared to our estimate of 10.9%) and the average implied market risk premium is 8.8% (compared to our estimate of 6.2%). The estimates prepared by Bloomberg also exclude any benefits from imputation.

The Bloomberg approach incorporates higher growth assumptions, especially in the short term, which leads to a higher estimated cost of equity. The Bloomberg process for transitioning from initial growth to long-term growth is summarised in Table 1. In the long term, the approach adopted by Bloomberg means that investments earn their cost of equity. So ultimately the estimates compiled by Bloomberg will lead to price/earnings ratios that are the inverse of the cost of equity.

[34] We reiterate that this estimate of the market risk premium does not include any tax benefits of imputation or other tax benefits. It represents the market risk premium from dividends and capital gains only.

Table 4. Market capitalisation-weighted estimates (%)

Period	N	Cost of equity excl imp ben	Long-term growth	Return on equity	Dividend yield	Risk-free rate	Market risk premium	Bloom-berg r_e	Bloom-berg ERP
2H02	143	10.3	5.9	19.6	3.9	5.6	4.7		
1H03	146	10.0	5.4	19.5	4.2	5.1	4.8		
2H03	150	10.3	5.8	19.6	4.3	5.6	4.7		
1H04	156	10.8	6.2	20.4	4.6	5.7	5.1		
2H04	164	10.8	6.1	19.3	4.6	5.5	5.3		
1H05	186	10.6	5.9	19.5	4.1	5.4	5.2		
2H05	168	10.6	5.4	21.7	4.0	5.3	5.3		
1H06	164	9.7	4.4	22.6	3.9	5.5	4.2		
2H06	188	10.2	4.8	22.5	4.3	5.7	4.5		
1H07	232	10.2	5.2	20.8	3.6	5.9	4.3		
2H07	253	10.2	5.4	21.0	3.7	6.1	4.1		
1H08	265	10.5	5.9	19.5	4.5	6.3	4.3		
2H08	244	10.7	5.5	18.5	5.2	5.4	5.3	13.2	7.8
1H09	228	11.3	6.4	17.7	5.4	4.6	6.7	16.0	11.4
2H09	263	10.6	6.2	16.9	4.4	5.5	5.2	12.0	6.5
1H10	283	10.5	6.0	17.9	4.1	5.5	5.0	13.7	8.2
2H10	274	10.8	5.9	18.6	4.3	5.2	5.7	15.6	10.4
1H11	281	10.7	5.7	18.5	4.4	5.4	5.3	14.7	9.3
2H11	261	11.1	6.1	18.0	4.7	4.3	6.8	14.4	10.0
1H12	268	11.6	6.5	17.7	4.8	3.7	7.9	12.7	9.0
2H12	253	10.9	5.8	17.1	4.7	3.1	7.8	11.4	8.3
1H13	265	10.2	6.0	16.3	4.3	3.4	6.8	10.5	7.1
Average	220	10.6	5.7	19.2	4.4	5.2	5.4		
2H02-1H08	185	10.3	5.5	20.5	4.1	5.6	4.7		
2H08-1H13	262	10.9	6.0	17.7	4.6	4.6	6.2	13.4	8.8

The cost of equity excluding imputation benefits is a market capitalisation-weighted average of the average cost of equity excluding imputation benefits estimates for each firm during the six month period. The risk-free rate is the average of daily annualised yields on 10-year government bonds. The market risk premium is then the difference between the market capitalisation-weighted average cost of equity and the average risk-free rate. The Bloomberg cost of equity is the average of the daily estimates of the cost of equity for Australia provided by Bloomberg, and the Bloomberg equity risk premium is simply the difference between the Bloomberg cost of equity estimate and the risk-free rate reported in the table. The dividend yield is the estimate from the first two forecast years, not the long-term dividend yield. Cost of equity estimates for the most recent period, 1H13, rely upon forecasts made from 1 January 2013 to 13 June 2013.

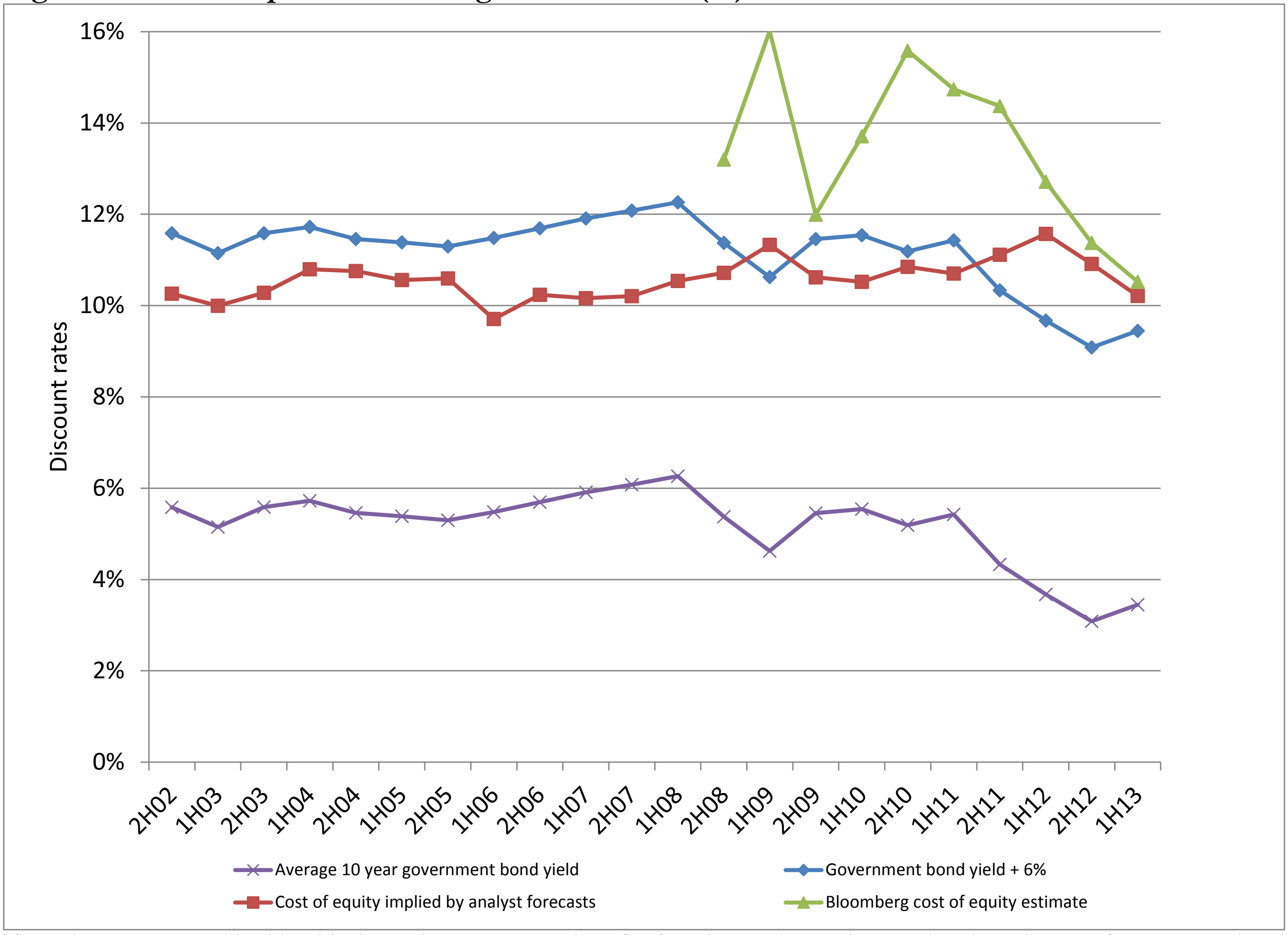
To see why this is the case, consider the equation for price in a constant growth state:

$$P = \frac{D_1}{r_e - g} = \frac{D_1}{r_e - RR \times ROE}$$

If the return on equity *(ROE)* is set equal to the cost of equity *(r_e)* then we have:

$$P = \frac{D_1}{r_e - g} = \frac{D_1}{r_e - RR \times r_e}$$

Figure 2. Market capitalisation-weighted estimates (%)



The estimates presented in this table do not incorporate any benefits from imputation. In interpreting the estimates of government bond yield + 6% (the AER's current approach), it should be noted that the return investors will receive from dividends and capital gains will be lower than this amount. If the AER's current approach is considered to be bond yield + 6%, then this is the regulated return under imputation. The cost of equity excluding imputation benefits will be this value multiplied by 0.9032.

Then if we set the reinvestment rate equal to (1 – Dividend payout ratio = 1 – D_1/E_1) we can solve for the price/earnings ratio:

$$
\begin{aligned}
P &= \frac{D_1}{r_e - (1 - D_1/E_1) \times r_e} \\
&= \frac{D_1}{r_e - r_e + D_1/E_1 \times r_e} \\
&= \frac{D_1}{D_1/E_1 \times r_e} \\
\frac{P}{E_1} &= \frac{1}{r_e}
\end{aligned}
$$

For example, take the average cost of equity excluding imputation benefits estimate of 10.2% for the last six month period. In the terminal growth state, if investments are expected to earn their cost of equity, the price/earnings ratio will be 9.8. In contrast, we allow for returns on equity to differ from the cost of equity. This leads to price/earnings ratios that are more consistent with what we actually observe in the market. Across our sample the average price/earnings ratio in the constant growth state is projected to be 14.6.

This long-term price/earnings ratio is also broadly consistent with the price/earnings ratios we observe for the largest and most mature listed firms. As a snapshot of the price/earnings ratios observed for very mature firms we compiled the listing dates for the ASX20. We then computed the price/earnings ratios over our sample period for firms listed for longer than 20 years prior to 1 July 2002. There were nine firms in this cohort, which were listed on average for 44 years prior to our sample period. The average price/earnings ratio for these firms over the sample period was 15.8.[35]

The important point is that we do not assume a return on equity which will prevail in the long-term, but rather simultaneously estimate the return on equity and the cost of equity. But if we were to assume that in the long term these values were equivalent, we would also implicitly assume that the price/earnings ratio will fall to values well below those observed for even the largest companies with the longest trading periods. Under the approach we have adopted, the average long-term price/earnings ratio of 14.6 is below the average price/earnings ratios actually observed for these firms of 15.8.

The reason the Bloomberg approach generates higher estimates for the cost of equity is that under the Bloomberg approach, growth rates remain high for a long period of time before reaching this constant growth state. So the Bloomberg process allows for, on average, higher returns on equity in the short term, and lower returns on equity in the long-term, with the net result being relatively higher estimates of the cost of equity.

4.3 Implied regulated return under imputation

In the analysis presented above we provide estimates of investors' required returns from the aggregate of dividends and capital gains. These estimates represent the discount rate which sets the present value of expected dividends equal to the price of the stock. It represents investors' return excluding any benefit from imputation.

These estimates of the cost of equity excluding imputation benefits need to be adjusted upwards to account for the tax benefits of imputation in the manner implemented by the AER. In Appendix 7.2 we document that the relationship between the cost of equity for regulation and the cost of equity excluding imputation benefits, as implemented by the AER, is given by the following equation. We have incorporated inputs for the corporate tax rate (τ) of 0.30 and the value of imputation credits (γ) of 0.25, consistent with the submission of the Victorian distribution businesses.[36]

$$\begin{aligned} Cost\ of\ equity\ for\ regulation &= Return\ excl\ imp\ benefits \div \left[\frac{1 - tax\ rate}{1 - tax\ rate \times (1-\gamma)}\right] \\ &= Return\ excl\ imp\ benefits \div \left[\frac{1 - 0.30}{1 - 0.30 \times (1-0.25)}\right] \\ &= \frac{Return\ excl\ imp\ benefits}{0.9032} \end{aligned}$$

With respect to the cost of equity estimates reported above this means the following. On average over all historical periods, the cost of equity excluding imputation benefits is estimated at 10.6%. This means that the required cost of equity for regulation would be 11.7% (that is, 0.106 ÷ 0.9032 = 11.7%).[37] For the most recent six month period the estimated cost of equity excluding imputation benefits is

[35] The specific firms are BHP (listed 117 years, P/E 14.7), Santos (listed 48 years, P/E 21.9), Origin (listed 41 years; P/E 20.1), Rio Tinto (listed 40 years, P/E 14.5), ANZ (listed 33 years, P/E 12.6), Westpac (listed 32 years, P/E 12.9), Woodside (listed 31 years, P/E 19.5), QBE (listed 29 years, P/E 13.2) and National Australia Bank (listed 28 years, P/E 12.3).

[36] If imputation credits were valued at 0.50 the divisor in the equation below would be 0.8235.

[37] If imputation credits were valued at 0.50 the cost of equity for regulation would be 12.8% (that is, 0.106 ÷ 0.8235 = 12.8%).

estimated at 10.2%. This means that the required cost of equity for regulation would be 11.3% (that is, 0.102 ÷ 0.9032 = 11.3%).[38]

[38] If imputation credits were valued at 0.50 the cost of equity for regulation would be 12.4% (that is, 0.102 ÷ 0.8235 = 12.4%).

5. Conclusion

Over the 11-year period from the second half of 2002 to the first half of 2013, the average estimated market cost of equity excluding imputation benefits is 10.6%. This estimate appears in Table 4. It is an equal-weighted average of the market cost of equity estimates compiled over 22 half-year periods. The average yield to maturity on 10-year government bonds over this period was 5.2%, which implies a market risk premium excluding imputation benefits estimate of 5.4%. Incorporating the benefits of imputation, as implemented by the AER, implies an average cost of equity for regulation over the period of 11.7% (assuming $\gamma = 0.25$).[39] This is a premium of 6.5% over the average yield on 10-year government bonds.[40]

For the most recent six month period ending in June 2013, the market cost of equity excluding imputation benefits is estimated at 10.2%. This is our best estimate of the expected return on the market, excluding imputation benefits, compiled from the dividend discount model. This estimate also appears in Table 4. For the most recent period the average yield on 10-year government bonds is 3.4%, which implies a market risk premium excluding imputation benefits estimate of 6.8%. Incorporating the benefits of imputation, as implemented by the AER, implies a cost of equity for regulation in the most recent period of 11.3%.[41] This is a premium of 7.9% over the yield on 10-year government bonds.[42]

The market expected return increases subsequent to the global financial crisis, which is consistent with expectations. These estimates represent equity investors' required returns from dividends and capital gains only. If compensation for imputation credits or other tax benefits forms part of the regulated return, then that regulated return must be higher than the figures presented here to account for those tax benefits.

In forming these estimates we incorporated an assumption that returns on investment, reinvestment rates and long-term growth rates revert to normal levels over time. But we do not impose values for these normal values. Rather, we select parameter inputs which set the present value of expected dividends equal to analyst price targets, and which allow for the smoothest transition to long-term growth. The resulting cost of equity estimates exhibit less dispersion than estimates which would result from the CAPM, if beta estimates are formed on the basis of regressions of historical stock returns on market returns. To the extent the AER considers variation in parameter estimates to be a potential basis for excluding, or giving less weight to, particular methodologies, our cost of equity estimates exhibit less variation over time than would result from adding 6% to the risk-free rate of interest, which is the current practice of the AER. They also increase during the period subsequent to the onset of the global financial crisis.

Prior regulatory consideration of the dividend discount model as a technique for estimating the cost of equity has focused on two concerns. There is concern about estimates of long-term growth and variation in estimates across analysts and over time. This consideration has been made with reference to implementation of a constant growth version of the dividend discount model, whereby the analyst imposes a judgment about the "correct" growth rate. But this basically means that the cost of equity is whatever the analyst decides it is – assume low growth rates and the cost of equity is low; assume high growth rates and the cost of equity is high. That is why it is crucial for the analyst to rely upon a systematic process for estimating growth, and not subjective judgement.

[39] If imputation credits are valued at 0.50 the cost of equity for regulation is 12.8%.

[40] If imputation credits are valued at 0.50 the cost of equity for regulation, relative to the average yield on 10-year government bonds, is 7.7%.

[41] If imputation credits are valued at 0.50 the cost of equity for regulation is 12.4%.

[42] If imputation credits are valued at 0.50 the cost of equity for regulation, relative to the average yield on 10-year government bonds, is 9.0%.

The mean-reverting process used in this report for estimation generates cost of equity estimates that are derived in an objective manner and generates outcomes consistent with actual market pricing. An alternative assumption sometimes invoked in dividend discount model analysis is that long-term investment returns equal the cost of equity. Under this assumption the long-term price/earnings ratio is the inverse of the cost of equity, which would imply price/earnings ratios well below what we actually observe for the largest, most mature firms. The long-term projected price/earnings ratios resulting from our analysis are closer to what we actually observe for these established firms.

6. References

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7. Appendices

7.1 Derivation of the growth in earnings per share

Growth in earnings per share *(g)* is the percentage change in earnings per share from years 1 (E_1) to 2 (E_2). It will be the same as growth in dividends per share if the reinvestment rate (*RR*) is constant. The reinvestment rate is the proportion of earnings per share not distributed as dividends, so is equal to one minus the dividend payout ratio (D_1/E_1). So we begin with the equation for growth in earnings per share.

$$g = \frac{E_2}{E_1} - 1$$

Earnings per share can be expressed as net profit after tax divided by shares on issue. We assume any new shares are only issued at the end of the year. So earnings per share in year two is $NPAT_2 \div N_2$ where N_2 is the number of shares on issue at the start of year 2. We have the corresponding expression for earnings per share in year one $(NPAT_1 \div N_1)$.

$$1 + g = \frac{NPAT_2}{N_2} \div \frac{NPAT_1}{N_1} = \frac{NPAT_2}{NPAT_1} \times \frac{N_1}{N_2}$$

Net profit after tax in year two can be expressed as the sum of three components – net profit after tax in year one, return on the reinvestment of year one earnings $(NPAT_1 \times RR \times ROE)$ and return on equity raised at the end of year one $[(N_2 - N_1) \times P_0 \times (1 + g) \times ROE]$.

$$1 + g = \frac{NPAT_1 + NPAT_1 \times RR \times ROE + (N_2 - N_1) \times P_0 \times (1 + g) \times ROE}{NPAT_1} \times \frac{N_1}{N_2}$$

If we then disaggregate the first factor into three terms, we have the equation below.

$$1 + g = \left[\frac{NPAT_1}{NPAT_1} + \frac{NPAT_1 \times RR \times ROE}{NPAT_1} + \frac{(N_2 - N_1) \times P_0 \times (1 + g) \times ROE}{NPAT_1}\right] \times \frac{N_1}{N_2}$$

$$1 + g = \left[1 + RR \times ROE + \frac{(N_2 - N_1) \times P_0 \times (1 + g) \times ROE}{N_1 \times E_1}\right] \times \frac{N_1}{N_2}$$

Then, factorising the term on the right-hand side we have the equation below.

$$1 + g = \frac{N_1}{N_2} + RR \times ROE \times \frac{N_1}{N_2} + \frac{(N_2 - N_1) \times P_0 \times (1 + g) \times ROE}{N_2 \times E_1}$$

Collecting (1 + g) on the left-hand side of the equation and then defining *C* as the percentage change in shares on issue $(N_2 - N_1) \div N_1$, we arrive at a final expression for growth.

$$(1 + g) \times \left(1 - \frac{N_2 - N_1}{N_2} \times \frac{P_0}{E_1} \times ROE\right) = \frac{N_1}{N_2} + \frac{N_1}{N_2} \times RR \times ROE$$

$$1 + g = \frac{\frac{N_1}{N_2} \times (1 + RR \times ROE)}{1 - \frac{N_2 - N_1}{N_2} \times \frac{P_0}{E_1} \times ROE}$$

$$1+g=\frac{\frac{N_1}{N_2}\times(1+RR\times ROE)}{\frac{N_2}{N_2}-\frac{N_2-N_1}{N_2}\times\frac{P_0}{E_1}\times ROE}$$

$$1+g=\frac{1+RR_1\times ROE}{\frac{N_2}{N_1}-\frac{N_2-N_1}{N_1}\times\frac{P_0}{E_1}\times ROE}$$

$$1+g=\frac{1+RR_1\times ROE}{1+C-C\times\frac{P_0}{E_1}\times ROE}$$

$$g=\frac{\frac{1+RR_1\times ROE}{1+C}}{1-\frac{C}{1+C}\times\frac{P_0}{E_1}\times ROE}-1$$

7.2 Regulated returns under imputation

7.2.1 Regulated return in the post-tax revenue model

In the analysis presented above we provide estimates of investors' required returns from the aggregate of dividends and capital gains. These estimates represent the discount rate which sets the present value of expected dividends equal to the price of the stock. The discount rate, in turn, represents investors' return excluding any benefit from imputation.

In this appendix we demonstrate the conversion between required returns excluding any imputation benefit, and the allowed rate of return, according to the post-tax revenue model used by the AER. The relationship described in this appendix is independent of any estimate contained in the body of this report. It simply shows that, given some allowed equity return by the AER, what return investors will receive excluding any benefit of imputation credits.

We show that under current inputs for the value of imputation credits (γ or "gamma" = 0.25) and the corporate tax rate (0.30) the relationship is as follows:

$$Cost\ of\ equity\ for\ regulation = Return\ excl\ imp\ benefits \div \left[\frac{1-tax\ rate}{1-tax\ rate\times(1-\gamma)}\right]$$

$$= Return\ excl\ imp\ benefits \div \left[\frac{1-0.30}{1-0.30\times(1-0.25)}\right]$$

$$=\frac{Return\ excl\ imp\ benefits}{0.9032}$$

This means that, for example, if the AER estimates a cost of equity of 13.0%, it also estimates that investors will receive a return excluding imputation benefits of 11.7%. If the AER estimates a cost of equity of 12.0%, it also estimates that investors will receive a return excluding imputation benefits of 10.8%, and so on.

The relationship between (a) the cost of equity for regulation and (b) equity holders' required return excluding imputation benefits is derived with reference to the AER's post-tax revenue model. To illustrate this relationship we provide an example with the following assumptions. The regulated asset base *(RAB)* is \$100, financed with 60% debt *(D* = \$60*)* and 40% equity *(E* = \$40*)*. The AER has allowed a cost of debt capital (r_d) of 8% and a cost of equity (r_e) of 12%. The statutory tax rate (τ) is 30% and the value of imputation credits (γ) is estimated at 0.25.

In its regulatory process the AER estimates the allowed rate of return[43] according to the following equation:

$$\boldsymbol{Allowed\ rate\ of\ return = r_e \times \frac{E}{RAB} + r_d \times \frac{D}{RAB}}$$

According to the assumptions in our example, the allowed rate of return is 9.6%, computed as 0.12 × 0.40 + 0.08 × 0.60 = 0.048 + 0.048 = 9.6%.

In this equation, which we refer to as the vanilla weighted average cost of capital, there is no mention of imputation credits. This is because imputation credits are accounted for as a cash flow item according to the following equation.[44]

$$\textit{Estimated cost of corporate tax} = (\textit{Estimated taxable income} \times \textit{Expected statutory tax rate}) \times (1 - \gamma)$$

In making an estimate of taxable income, the AER implements the following equation:[45]

$$Estimated\ taxable\ income = \frac{Regulated\ asset\ base\ (RAB) \times Allowed\ rate\ of\ return + Regulatory\ depn - Tax\ depn - Interest}{1 - \tau \times (1 - \gamma)}$$

In the case where regulatory depreciation and tax depreciation are equal, these terms fall out of the equation. Setting interest equal to the cost of debt *(r_d)* times the amount of debt *(D)* we have:

$$\begin{aligned} Estimated\ taxable\ income &= \frac{RAB \times \left(r_e \times \frac{E}{RAB} + r_d \times \frac{D}{RAB}\right) - r_d \times D}{1 - \tau \times (1 - \gamma)} \\ &= \frac{r_e \times E}{1 - \tau \times (1 - \gamma)} \end{aligned}$$

Incorporating the estimated taxable income into the equation for the estimated cost of corporate tax we have:

$$Estimated\ cost\ of\ corporate\ tax = r_e \times E \times \left[\frac{\tau \times (1 - \gamma)}{1 - \tau \times (1 - \gamma)}\right]$$

Continuing with our example, the estimated cost of corporate income tax is \$1.39 as shown below:

$$\begin{aligned} Estimated\ cost\ of\ corporate\ tax &= 0.12 \times \$40 \times \left[\frac{0.30 \times (1 - 0.25)}{1 - 0.30 \times (1 - 0.25)}\right] \\ &= \$4.80 \times \left[\frac{0.225}{0.775}\right] \\ &= \$4.80 \times 0.290 \\ &= \$1.39 \end{aligned}$$

[43] National Electricity Rules 6.5.2.

[44] National Electricity Rules 6.5.3.

[45] Transmission post-tax revenue model – version 2 – December 2010. In the model, operating expenses are added into the equation and taken away again so we do not present operating expenses in the equation.

Table 5. Relationship between cost of equity for regulation and return excluding imputation benefits

Component	Equation	Example
RAB × Allowed rate of return	$E \times r_e + D \times r_d$	\$9.60
+ Estimated cost of corporate tax	$E \times r_e \times \left[\frac{\tau \times (1-\gamma)}{1-\tau \times (1-\gamma)}\right]$	\$1.39
= Earnings before interest and tax	$E \times r_e \times \left\{1 + \left[\frac{\tau \times (1-\gamma)}{1-\tau \times (1-\gamma)}\right]\right\} + D \times r_d$ $= E \times r_e \times \left[\frac{1}{1-\tau \times (1-\gamma)}\right] + D \times r_d$	\$10.99
– Interest	$D \times r_d$	\$4.80
= Taxable income	$E \times r_e \times \left[\frac{1}{1-\tau \times (1-\gamma)}\right]$	\$6.19
– Tax payable	$E \times r_e \times \left[\frac{1}{1-\tau \times (1-\gamma)}\right] \times \tau$	\$1.86
= Net profit after tax	$E \times r_e \times \left[\frac{1-\tau}{1-\tau \times (1-\gamma)}\right]$	4.34
Return excluding imputation benefits	$\frac{NPAT}{E} = r_e \times \left[\frac{1-\tau}{1-\tau \times (1-\gamma)}\right]$	10.84%

If we add together the allowed return on capital and the cost of corporate tax, we have earnings before interest and tax (EBIT). With this computation of EBIT we can work through the income statement in order to arrive at the expected return to equity holders excluding imputation benefits (Net profit after tax ÷ Equity). This is presented in Table 5.

The final line in the table shows the relationship between the return excluding imputation benefits and the cost of equity for regulation. This is exactly the same relationship presented in Officer (1994). It says that:

$$Return\ from\ dividends\ and\ capital\ gains = r_e \times \left[\frac{1-\tau}{1-\tau \times (1-\gamma)}\right]$$

Officer (1994) considered the case in which the expected cash flows are level perpetuity, and the cases covered by the AER are not cases of a level perpetuity. But this is the process by which the AER determines the allowed return to equity holders in its post-tax revenue model.

7.2.2 Inferring a regulated cost of equity from an estimate of return excluding imputation benefits

In the previous sub-section we presented the equation for the relationship between the return excluding imputation benefits and the cost of equity for regulation. If we have an estimate of investors' return excluding imputation benefits, and need to make an estimate of the cost of equity for regulation, we have the following relationship:

$$r_e = Return\ excluding\ imputation\ benefits \div \left[\frac{1-\tau}{1-\tau \times (1-\gamma)}\right]$$

Under the assumptions of $\tau = 0.30$ and $\gamma = 0.25$ the cost of equity under regulation = return excluding imputation benefits ÷ 0.9032.

Table 6. Cost of equity under regulation that is consistent with return excluding imputation benefits (%)

Return excluding imputation benefits	9.00	10.00	11.00	12.00	13.00
$\gamma = 0.00$	9.00	10.00	11.00	12.00	13.00
$\gamma = 0.05$	9.19	10.21	11.24	12.26	13.28
$\gamma = 0.10$	9.39	10.43	11.47	12.51	13.56
$\gamma = 0.15$	9.58	10.64	11.71	12.77	13.84
$\gamma = 0.20$	9.77	10.86	11.94	13.03	14.11
$\gamma = 0.25$	9.96	11.07	12.18	13.29	14.39
$\gamma = 0.30$	10.16	11.29	12.41	13.54	14.67
$\gamma = 0.35$	10.35	11.50	12.65	13.80	14.95
$\gamma = 0.40$	10.54	11.71	12.89	14.06	15.23
$\gamma = 0.45$	10.74	11.93	13.12	14.31	15.51
$\gamma = 0.50$	10.93	12.14	13.36	14.57	15.79

In the analysis presented in the main body of the text we provided an estimate for the market return of 10.2% for the most recent six month period, and an estimate of 10.6% over the 11 years of analysis. These are estimates of the return excluding imputation benefits, so to arrive at the cost of equity for regulation, given current parameter inputs, we need to divide these estimates by 0.9032. For the most recent six month period the required return would be 11.3% (10.2% ÷ 0.9032= 11.3%) and, on average over the entire estimation period the required return would be 12.8% (10.6% ÷ 0.9032 = 12.4%).

In Table 6 we present a grid of values for the cost of equity under regulation, given alternative assumptions for the value of imputation credits and the return excluding imputation benefits. Computations assume a corporate tax rate of 30%.

8. 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. The opinions of Professor Gray and Dr Hall in the report are based wholly or substantially on the specialised knowledge which Professor Gray and Dr Hall have.

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.

TERMS OF REFERENCE – DIVIDEND GROWTH MODEL

Background

The Victorian electricity distribution businesses (the **Vic DBs**)[1] are required, pursuant to the AMI Cost Recovery Order (as amended) to make a revised charges application (charges revision application) to set revised changes in respect of advanced metering infrastructure (AMI) for the year commencing 1 January 2014 by 31 August 2013.

The AMI Cost Recovery Order provides that the return on capital to be applied in determining charges for 2014 and 2015 is to be determined as a weighted average cost of capital (WACC), calculated in accordance with the formula set out in clause 6.5.2(b) of the National Electricity Rules (**NER**). Note that the references to the NER in the AMI Cost Recovery Order should to be read as references to the version of the NER that applied before those rules were amended in November 2012 (that is, version 52 of the NER). As you would be aware, the rules relating to the rate of return were significantly amended in November 2012. These amendments included the replacement of the obligation on the Australian Energy Regulator (**AER**) to issue a statement of regulatory intent dealing with various cost of capital matters, with an obligation to issue cost of capital guidelines, which it is envisaged will take a significantly different form from the previous statement of regulatory intent. References in this terms of reference to the NER should be read as references to version 52 of the NER.

In relation to measurement of individual parameters within the WACC formula, the AMI Cost Recovery Order provides that:

- measurement of "market observables" (defined as the nominal risk free rate and the debt risk premium) is to occur in a period in 2013 proposed by the relevant business and agreed by the AER; and
- market observables and non-market observables are to be determined in accordance with the Statement of Regulatory Intent (**SoRI**) issued by the AER pursuant to clause 6.5.4 of the NER and as if clause 6.5.4(g) of the NER applied.

Clause 6.5.2(b) of the NER provides that the return on capital must be calculated as a nominal post-tax weighted average cost of capital, in accordance with a prescribed formula, as follows:

$$WACC = k_e (E/V) + k_d (D/V)$$

where:

k_e is the return on equity (determined using the Capital Asset Pricing Model) and is calculated as

[1] The Vic DBs include United Energy Distribution, SPI Electricity, CitiPower, Powercor, and Jemena Electricity Networks (Vic).

$r_f + ß_e \times MRP$

where:

r_f is the nominal risk free rate for the regulatory control period. It is to be calculated on a moving average basis from the annualised yield on Commonwealth Government Securities (CGS);

β_e is the equity beta with a SoRI value of 0.8; and

MRP is the market risk premium.

k_d is the return on debt and is calculated as:

$r_f + DRP$

where:

DRP is the debt risk premium for the regulatory control period. The debt risk premium for a regulatory control period is the premium determined for that regulatory control period by the AER as the margin between the annualised nominal risk free rate and the observed annualised Australian benchmark corporate bond rate for corporate bonds which have a maturity equal to that used to derive the nominal risk free rate and a credit rating from a recognised credit rating agency.

E/V is the value of equity as a proportion of the value of equity and debt, which is 1 – D/V; and

D/V is the value of debt as a proportion of the value of equity and debt.

Clause 6.5.4 of the NER details the basis on which the AER must develop a SoRI in relation to the rate of return. On 1 May 2009, the AER issued its SoRI in accordance with clause 6.5.4 of the NER, in which it set out (among other things) a value for the MRP of 6.5%.

Clause 6.5.4(g) of the Rules states that a distribution determination to which a SoRI is applicable must be consistent with the statement unless there is persuasive evidence justifying a departure, in the particular case, from a value, method or credit rating level set in the statement. As noted above, the relevant market observables are to be determined as if this clause applied, which implies that the determination of these parameters for the purposes of the Vic DBs' charges revision applications must be consistent with the SoRI unless there is persuasive evidence justifying a departure.

In this context, and as further detailed below, the Vic DBs would like to engage you to provide your best estimate of the forward-looking expected return on the market and expected market risk premium determined using the dividend growth model (**DGM**). This analysis may be relevant to determining whether there is persuasive evidence justifying a departure from the value for the MRP set out in the SoRI (a value of 6.5%), in the current circumstances.

Scope of work

The Vic DBs request you to provide your best estimate of the forward-looking expected return on the market and the market risk premium (being the difference between the expected return on the market and the risk free rate over the same period) using the DGM.

Estimates of the forward-looking expected return on the market and the market risk premium should be provided for the following periods:

- the period from 1 January 2013 to 30 June 2013;
- the period from 1 July 2002 to 30 June 2013.

Your analysis and findings should:

- Consider different versions of the DGM that maybe relevant to Australia, including both the Gordon growth model (GGM) and the DGM used by the Federal Energy Regulatory Commission (FERC) and other regulators in the US;
- Use robust methods and data to estimate input parameters, recognising:
  - any interrelationship between parameters, such as between share prices and expected dividend growth;
  - any differences between the return on invested earnings and the cost of capital; and
  - any differences in applying the DGM to listed and unlisted firms;
- Use the most recent data available and necessary to estimate current forward-looking estimates of the expected return on the market and the market risk premium;
- Consider any comments raised by the AER (and its consultants, such as Associate Professor Lally) and other regulators about the applicability and reliability of the DGM in Australia, including the sensitivity of cost of equity estimates to the growth rate assumption;
- Provide a method for grossing up stock returns for the value of imputation credits;
- Identify and provide reasons for the growth and dividend yield assumptions used to estimate the cost of equity;[2]
- State your opinion as to whether the DGM should be applied using a "constant growth" or "mean reversion" assumption (or some other assumption as to long term growth), including reasons for this opinion; and
- Indicate the sensitivity of your results to any key assumptions made.

The Vic DBs request the consultant to provide a report that must:

- Attach these terms of reference and the qualifications (in the form of CV(s) of the person(s) preparing the report;
- Identify any current or potential future conflicts of interest;
- Comprehensively set out the bases for any conclusions made;
- Only rely on information or data that is fully referenced and could be made reasonably available to the AER or others;
- Document the methods, data, adjustments, equations, statistical package specifications/printouts and assumptions used in preparing your opinion;[3]

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[2] Martin Lally raised a particular point that the future growth in dividends per share will be constrained by the growth in per capita income. See Lally, *The cost of equity and the market risk premium*, 25 July 2012. The consultant is required to address this point.

- Include specified wording at the beginning of the report stating that “[the person(s)] acknowledge(s) that [the person(s)] has 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” as if your brief was in the context of litigation;
- Include specified wording at the end of the report to declare that “[the person(s)] has made all the inquiries that [the person(s)] believes are desirable and appropriate and that no matters of significance that [the person(s)] regards as relevant have, to [the person(s)] knowledge, been withheld”;
- Contain an acknowledgement that the opinions in the report are based wholly or substantially on the specialised knowledge which the person(s) preparing the report have; and
- State that the person(s) 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” and that the Report has been prepared in accordance with those Guidelines, refer to Annexure A to these Terms of Reference or alternatively online at <*http://www.federalcourt.gov.au/law-and-practice/practice-documents/practice-notes/cm7*>.

Timeframe

The consultant is to provide a draft report by 15 August 2013 and a final report by 26 August 2013.

Fees

The consultant is requested to:

- Propose a fixed total cost of the project and hourly rates for the proposed project team should additional work be required;
- Advise the staff who will provide the strategic analysis and opinion;
- Declare the absence of any relevant conflict of interest in undertaking the project; and
- Indicate preparedness to enter into a confidentiality agreement regarding research and findings.

Miscellaneous costs such as travel and accommodation will be reimbursed, provided that they are agreed with the Vic DBs beforehand.

Contacts

Any questions regarding this terms of reference should be directed to:

Catherine Dermody

Email: CDermody@gtlaw.com.au

Phone: 03 8656 3320.

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[3] If this requirements will result in you revealing information that you might otherwise regard as proprietary or confidential and this causes you commercial concern, please consult us on a legal framework which can be put in place to protect your proprietary material while enabling your work to be adequately transparent and replicable.

Annexure A

FEDERAL COURT OF AUSTRALIA

Practice Note CM 7

EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).

3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[1], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

<u>Guidelines</u>

1. General Duty to the Court[2]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

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[1] As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

[2] The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.

2. The Form of the Expert's Report[3]

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

(ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above[4]; and

(h) comply with the Practice Note.

2.2 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that* [the expert] *believes are desirable and appropriate and that no matters of significance that* [the expert] *regards as relevant have, to* [the expert's] *knowledge, been withheld from the Court*."

2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[5].

2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

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[3] Rule 23.13.

[4] See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

[5] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565

2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[6].

3. Experts' Conference

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP
Chief Justice
4 June 2013

[6] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565-566. See also Ormrod *"Scientific Evidence in Court"* [1968] Crim LR 240

Stephen F. Gray

University of Queensland
Business School
Brisbane 4072
AUSTRALIA
Office: +61-7-3346 8032
Email: s.gray@business.uq.edu.au

Academic Qualifications

1995 Ph.D. (Finance), Graduate School of Business, Stanford University.
Dissertation Title: Essays in Empirical Finance
Committee Chairman: Ken Singleton

1989 LL.B. (Hons), Bachelor of Laws with Honours, University of Queensland.

1986 B.Com. (Hons), Bachelor of Commerce with Honours, University of Queensland.

Employment History

2000-Present Professor of Finance, UQ Business School, University of Queensland.

1997-2000 Associate Professor of Finance, Department of Commerce, University of Queensland and Research Associate Professor of Finance, Fuqua School of Business, Duke University.

1994-1997 Assistant Professor of Finance, Fuqua School of Business, Duke University.

1990-1993 Research Assistant, Graduate School of Business, Stanford University.

1988-1990 Assistant Professor of Finance, Department of Commerce, University of Queensland.

1987 Specialist Tutor in Finance, Queensland University of Technology.

1986 Teaching Assistant in Finance, Department of Commerce, University of Queensland.

Academic Awards

2006 Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.

2002 Journal of Financial Economics, All-Star Paper Award, for Modeling the Conditional Distribution of Interest Rates as a Regime-Switching Process, JFE, 1996, 42, 27-62.

2002 Australian University Teaching Award – Business (a national award for all university instructors in all disciplines).

2000 University of Queensland Award for Excellence in Teaching (a University-wide award).

1999 Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.

1999 KPMG Teaching Prize, Department of Commerce, University of Queensland.

1998 Faculty Teaching Prize (Business, Economics, and Law), University of Queensland.

1991 Jaedicke Fellow in Finance, Doctoral Program, Graduate School of Business, Stanford University.

1989 Touche Ross Teaching Prize, Department of Commerce, University of Queensland.

1986 University Medal in Commerce, University of Queensland.

Large Grants (over $100, 000)

- Australian Research Council Linkage Grant, 2008—2010, Managing Asymmetry Risk ($320,000), with T. Brailsford, J.Alcock, and Tactical Global Management.
- Intelligent Grid Cluster, Distributed Energy – CSIRO Energy Transformed Flagship Collaboration Cluster Grant, 2008-2010 ($552,000)
- Australian Research Council Research Infrastructure Block Grant, 2007—2008, Australian Financial Information Database ($279,754).
- Australian Research Council Discovery Grant, 2006—2008, Capital Management in a Stochastic Earnings Environment ($270,000).
- Australian Research Council Discovery Grant, 2005—2007, Australian Cost of Equity.
- Australian Research Council Discovery Grant, 2002—2004, Quantification Issues in Corporate Valuation, the Cost of Capital, and Optimal Capital Structure.

- Australian Research Council Strategic Partnership Grant, 1997—2000, Electricity Contracts and Securities in a Deregulated Market: Valuation and Risk Management for Market Participants.

Current Research Interests

Benchmark returns and the cost of capital. Corporate Finance. Capital structure. Real and strategic options and corporate valuation. Financial and credit risk management. Empirical finance and asset pricing.

Publications

Chan, K-F., R. Brooks, S. Treepongkaruna and S. Gray, (2011), "Do Trading Hours Affect Volatility Links in the Foreign Exchange Market?" *Australian Journal of Management*, forthcoming.

Chan, K-F., R. Brooks, S. Treepongkaruna and S. Gray, (2010), "Asset market linkages: Evidence from financial, commodity and real estate assets," *Journal of Banking and Finance*, forthcoming.

Parmenter, B, A. Breckenridge, and S. Gray, (2010), 'Economic Analysis of the Government's Recent Mining Tax Proposals', *Economic Papers*: *A Journal of Economics and Policy*, 29(3), September, 279-91.

Gray, S., C. Gaunt and Y. Wu, (2010), "A comparison of alternative bankruptcy prediction models," *Journal of Contemporary Accounting and Economics*, 6, 1, 34-45.

Feuerherdt, C., S. Gray and J. Hall, (2010), "The Value of Imputation Tax Credits on Australian Hybrid Securities," *International Review of Finance*, 10, 3, 365-401.

Gray, S., J. Hall, D. Klease and A. McCrystal, (2009), "Bias, stability and predictive ability in the measurement of systematic risk," *Accounting Research Journal*, 22, 3, 220-236.

Treepongkaruna, S. and S. Gray, (2009), "Information volatility links in the foreign exchange market," *Accounting and Finance*, 49, 2, 385-405.

Costello, D., S. Gray, and A. McCrystal, (2008), "The diversification benefits of Australian equities," *JASSA*, 2008, 4, 31-35.

Gray, S. and J. Hall, (2008), "The Relationship Between Franking Credits and the Market Risk Premium: A Reply," *Accounting and Finance*, 48, 1, 133-142.

Gray, S., A. Mirkovic and V. Ragunathan, (2006), "The Determinants of Credit Ratings: Australian Evidence," *Australian Journal of Management*, 31(2), 333-354.

Choy, E., S. Gray and V. Ragunathan, (2006), "The Effect of Credit Rating Changes on Australian Stock Returns," *Accounting and Finance*, 46(5), 755-769.

Gray, S. and J. Hall, (2006), "The Relationship Between Franking Credits and the Market Risk Premium," *Accounting and Finance*, 46(3), 405-428.

Gray, S. and S. Treepongkaruna, (2006), "Are there non-linearities in short-term interest rates?" *Accounting and Finance*, 46(1), 149-167.

Gray, P., S. Gray and T. Roche, (2005), "A Note on the Efficiency in Football Betting Markets: The Economic Significance of Trading Strategies," *Accounting and Finance*, 45(2) 269-281.

Duffie, D., S. Gray and P. Hoang, (2004), "Volatility in Energy Prices. In V. Kaminski," (Ed.), *Managing Energy Price Risk: The New Challenges and Solutions* (3rd ed.). London: Risk Books.

Cannavan, D., F. Finn and S. Gray, (2004), "The Value of Dividend Imputation Tax Credits in Australia," *Journal of Financial Economics*, 73, 167-197.

Gray, S. and S. Treepongkaruna, (2003), "Valuing Interest Rate Derivatives Using a Monte-Carlo Approach," *Accounting and Finance*, 43(2), 231-259.

Gray, S., T. Smith and R. Whaley, (2003), "Stock Splits: Implications for Investor Trading Costs," *Journal of Empirical Finance*, 10, 271-303.

Gray, S. and S. Treepongkaruna, (2003), "On the Robustness of Short-term Interest Rate Models," *Accounting and Finance*, 43(1), 87-121.

Gray, S. and S. Treepongkaruna, (2002), "How to Value Interest Rate Derivatives in a No-Arbitrage Setting," *Accounting Research Journal* (15), 1.

Gray, P. and S. Gray, (2001), "A Framework for Valuing Derivative Securities," *Financial Markets Institutions & Instruments,* 10(5), 253-276.

Gray, P. and S. Gray, (2001), "Option Pricing: A Synthesis of Alternate Approaches," *Accounting Research Journal*, 14(1), 75-83.

Dahlquist, M. and S. Gray, (2000), "Regime-Switching and Interest Rates in the European Monetary System," *Journal of International Economics,* 50(2), 399-419.

Bollen, N., S. Gray and R. Whaley, (2000), "Regime-Switching in Foreign Exchange Rates: Evidence from Currency Options," *Journal of Econometrics*, 94, 239-276.

Duffie, D., S. Gray and P. Hoang, (1999), "Volatility in Energy Prices. In R. Jameson," (Ed.), *Managing Energy Price Risk* (2nd ed.). London: Risk Publications.

Gray, S. and R. Whaley, (1999), "Reset Put Options: Valuation, Risk Characteristics, and an Example," *Australian Journal of Management*, 24(1), 1-21.

Bekaert, G. and S. Gray, (1998), "Target Zones and Exchange Rates: An Empirical Investigation," *Journal of International Economics*, 45(1), 1-35.

Gray, S. and R. Whaley, (1997), "Valuing S&P 500 Bear Market Warrants with a Periodic Reset," *Journal of Derivatives*, 5(1), 99-106.

Gray, S. and P. Gray, (1997), "Testing Market Efficiency: Evidence from the NFL Sports Betting Market," *The Journal of Finance*, 52(4), 1725-1737.

Gray, S. (1996), "Modeling the Conditional Distribution of Interest Rates as a Regime- Switching Process," *Journal of Financial Economics*, 42, 27-62.

Gray, S. (1996), "Regime-Switching in Australian Interest Rates," *Accounting and Finance*, 36(1), 65-88.

Brailsford, T., S. Easton, P.Gray and S. Gray, (1995), "The Efficiency of Australian Football Betting Markets," *Australian Journal of Management*, 20(2), 167-196.

Duffie, D. and S. Gray, (1995), "Volatility in Energy Prices," In R. Jameson (Ed.), *Managing Energy Price Risk,* London: Risk Publications.

Gray, S. and A. Lynch, (1990), "An Alternative Explanation of the January Anomaly," *Accounting Research Journal*, 3(1), 19-27.

Gray, S. (1989), "Put Call Parity: An Extension of Boundary Conditions," *Australian Journal of Management*, 14(2), 151-170.

Gray, S. (1988), "The Straddle and the Efficiency of the Australian Exchange Traded Options Market," *Accounting Research Journal*, 1(2), 15-27.

<u>Teaching</u>

Fuqua School of Business, Duke University, Student Evaluations (0-7 scale):

- Financial Management (MBA Core): Average 6.5 over 7 years.
- Advanced Derivatives: Average 6.6 over 4 years.
- Empirical Issues in Asset Pricing: Ph.D. Class

1999, 2006 Outstanding Professor Award, Global Executive MBA, Fuqua School of Business, Duke University.

UQ Business School, University of Queensland, Student Evaluations (0-7 scale):

- Finance (MBA Core): Average 6.6 over 10 years.
- Corporate Finance Honours: Average 6.9 over 10 years.

2002 Australian University Teaching Award – Business (a national award for all university instructors in all disciplines).

2000 University of Queensland Award for Excellence in Teaching.
1999 Department of Commerce KPMG Teaching Prize, University of Queensland.
1998 Faculty Teaching Prize, Faculty of Business Economics and Law, University of Queensland.
1998 Commendation for Excellence in Teaching, University-wide Teaching Awards, University of Queensland.
1989 Touche Ross Teaching Prize, Department of Commerce, University of Queensland.

Board Positions

2002 - Present: Director, Financial Management Association of Australia Ltd.
2003 - Present: Director, Moreton Bay Boys College Ltd. (Chairman since 2007).
2002 - 2007: External Risk Advisor to Board of Enertrade (Queensland Power Trading Corporation Ltd.)

Consulting

Managing Director, Strategic Finance Group: www.sfgconsulting.com.au.

Consulting interests and specialties, with recent examples, include:

- **Corporate finance**
  - ⇒ **Listed multi-business corporation:** Detailed financial modeling of each business unit, analysis of corporate strategy, estimation of effects of alternate strategies, development of capital allocation framework.

- **Capital management and optimal capital structure**
  - ⇒ **State-owned electricity generator:** Built detailed financial model to analyze effects of increased leverage on cost of capital, entity value, credit rating, and stability of dividends. Debt of $500 million issued.

- **Cost of capital**
  - ⇒ **Cost of Capital in the Public Sector:** Provided advice to a government enterprise on how to estimate an appropriate cost of capital and benchmark return for Government-owned enterprises. Appearance as **expert witness** in legal proceedings that followed a regulatory determination.
  - ⇒ **Expert Witness:** Produced a written report and provided court testimony on issues relating to the cost of capital of a cable TV business.
  - ⇒ **Regulatory Cost of Capital:** Extensive work for regulators and regulated entities on all matters relating to estimation of weighted-average cost of capital.

- **Valuation**
  - ⇒ **Expert Witness:** Produced a written report and provided court testimony. The issue was whether, during a takeover offer, the shares of the bidding firm were affected by a liquidity premium due to its incorporation in the major stock market index.
  - ⇒ **Expert Witness:** Produced a written report and provided court testimony in relation to valuation issues involving an integrated mine and refinery.

- **Capital Raising**
  - ⇒ Produced comprehensive valuation models in the context of capital raisings for a range of businesses in a range of industries including manufacturing, film production, and biotechnology.

- **Asset pricing and empirical finance**
  - ⇒ **Expert Witness:** Produced a written report on whether the client's arbitrage-driven trading strategy caused undue movements in the prices of certain shares.

- **Application of econometric techniques to applied problems in finance**
  - ⇒ **Debt Structure Review:** Provided advice to a large City Council on restructuring their debt portfolio. The issues involved optimisation of a range of performance measures for each business unit in the Council while simultaneously minimizing the volatility of the Council's equity in each business unit.

- ⇒ **Superannuation Fund Performance Benchmarking:** Conducted an analysis of the techniques used by a large superannuation fund to benchmark its performance against competing funds.

- **Valuation of derivative securities**
  - ⇒ **Stochastic Volatility Models in Interest Rate Futures Markets:** Estimated and implemented a number of models designed to predict volatility in interest rate futures markets.

- **Application of option-pricing techniques to real project evaluation**
  - ⇒ **Real Option Valuation:** Developed a framework for valuing an option on a large office building. Acted as arbitrator between the various parties involved and reached a consensus valuation.
  - ⇒ **Real Option Valuation:** Used real options framework in the valuation of a bio-tech company in the context of an M&A transaction.

17 June 2013

Jason Hall, PhD BCom(Hons) CFA

Director
SFG Consulting
Level 1, South Bank House, Stanley Street Plaza
South Bank, Queensland, Australia 4101
Phone: 61-7-3844 0684
Australia mobile: +61 419 120 348
j.hall@sfgconsulting.com.au

Experience

2000-12	University of Queensland Business School, The University of Queensland (Senior Lecturer)
2008	Ross School of Business, The University of Michigan (Visiting Assistant Professor in Finance)
1997-99	Credit Suisse First Boston (Equities analyst)

Education

2005	PhD in finance from The University of Queensland
2003	Chartered Financial Analyst designation by the CFA Institute
1996	Bachelor of Commerce with First Class Honours from The University of Queensland

Research

Journal articles

Impact of sector versus security choice on equity portfolios, with Ben McVicar, *Applied Financial Economics*, 2013, 23 (12), 991 – 1004.

Unconstrained estimates of the equity risk premium, with Stephen Gray, Tristan Fitzgerald and Ravi Jeyaraj, *Review of Accounting Studies*, 2013, 18 (2), 560 – 639.

Market risk exposure of merger arbitrage in Australia, with Matthew Pinnuck and Matthew Thorne, *Accounting and Finance*, 2013, 53 (1), 185 – 215.

The value of imputation credits on hybrid securities, with Clinton Feuerherdt and Stephen Gray, *International Review of Finance*, 2010, 10 (3), 365 – 401.

Forecast accuracy and stock recommendations, with Paul Tacon, *Journal of Contemporary Accounting and Economics*, 2010, 6 (1), 18 – 33.

Speculation and e-commerce: The long and the short of IT, with Colin Ferguson, Matthew Pinnuck and Frank Finn, *International Journal of Accounting Information Systems*, 2010, 11 (2), 79 – 104.

Bias, stability and predictive ability in the measurement of systematic risk, with Stephen Gray, Drew Klease and Alan McCrystal, *Accounting Research Journal*, 2009, 22 (3), 220 – 236.

Leveraged superannuation, with Peter Dunn and Scott Francis, *Accounting and Finance*, 2009, 49 (3), 505 – 529.

Persistence in growth versus market expectations, with Matthew Tochterman, *Australian Journal of Management*, 2008, 33 (1), 169 – 199.

Relationship between franking credits and the market risk premium: A reply, with Stephen Gray, *Accounting and Finance*, 2008, 48 (1), 133 – 142.

Comment on ‘Regulation and the term of the risk free rate: Implications of corporate debt’, *Accounting Research Journal*, 2007, 20 (2), 81 – 86.

Valuation of mining projects using option pricing techniques, with Shannon Nicholls, *JASSA*, 2007, Issue 4 (Summer), 22 – 29.

Relationship between franking credits and the market risk premium, with Stephen Gray, *Accounting and Finance*, 2006, 46 (3), 405 – 428.

Electronic commerce investments, the resource-based view of the firm, and firm market value, with Colin Ferguson and Frank Finn, *International Journal of Accounting Information Systems*, 2005, 6 (1), 5 – 29.

Auditor conservatism and voluntary disclosure: Evidence from the Year 2000 systems issue, with Peter Clarkson and Colin Ferguson, *Accounting and Finance*, 2003, 43 (1), 21 – 40.

Working papers

The impact of security analyst recommendations on the trading of mutual funds, with David Costello, AFAANZ Conference 2010 (Winner Best Paper in Finance), Australasian Finance and Banking Conference 2010, undergoing revisions for re-submission to *Journal of Contemporary Accounting and Economics.*

Portfolio rebalancing and mutual fund tournament behavior, with Paul Tacon, Finance and Corporate Governance Conference 2011, FIRN Frontiers in Finance Conference 2011, Financial Management Association Annual Meeting 2012, undergoing revisions for re-submission to *Financial Management.*

Forecasting stock returns using investor flows under short-sales constraints, with Paul Tacon, Australasian Finance and Banking Conference 2011, Finance and Corporate Governance Conference 2012, AFAANZ Conference 2012, Financial Management Association Annual Meeting 2012, Southern Finance Association Annual Meeting 2012.

Presentations

Accounting and Finance Association of Australia and New Zealand Conference (5) 2005, 2007, 2009-10, 2012
Asian Finance Association Conference 2009
Australasian Finance and Banking Conference (2) 2008, 2010
Australian National University Seminar Series 2012
Coal Trade, hosted by AIC Worldwide 1999
Coaltrans Asia, hosted by Coaltrans Conference Limited 1999
Contemporary Accounting Research/Journal of Contemporary Accounting and Economics Joint Symposium 2009
CPA Mining and Energy Conference 2006
Financial Management Association 2012
First Annual Private Equity Conference, hosted by Television Education Network 2007
JBWere Family Business Conference 2010
Melbourne Centre for Consumer Finance Investment & Regulatory Symposium 2008
PhD Conference in Economics and Business, hosted by University of Western Australia 2003
Southern Finance Association 2012
University of Melbourne Seminar Series (2) 2005, 2010
University of Queensland Seminar Series 2008

Referee activity

Accounting and Finance (8 reviews) 2003, 2005, 2009-13
Accounting Research Journal (3 reviews) 2002, 2006, 2010
Applied Financial Economics (3 reviews) 2012-13
Australian Journal of Management 2012
Contemporary Economic Policy 2011
Financial Review 2013
International Journal of Emerging Markets 2013
International Review of Finance 2012
MIS Quarterly 2003
Quarterly Journal of Finance and Accounting 2010
Quarterly Review of Economics and Finance 2012

Research grants

PricewaterhouseCoopers/Accounting and Finance Association of Australia and New Zealand 2006: Returns, tax and volatility – Superannuation choice with a complete information set ($8,500)
Australian Research Council Discovery Grant 2002-4: Quantification issues in corporate valuation, the cost of capital and optimal capital structure ($126,000)
UQ New Staff Research Start-up Fund: The competitive advantage of investments in electronic commerce ($10,000)

Research students

PhD (1 student)
2012 – Paul Tacon
Honours (20 students)
2012 – Edward Parslow (Carnegie Wylie)
2011 – James Lamb (Port Jackson Partners)
2010 – Jeremy Evans (JP Morgan), Sarah Thorne (JP Morgan), Alexandra Dwyer (Reserve Bank of Australia)
2009 – Tristan Fitzgerald (UNSW), David Costello (National Australia Bank), William Toe (Ernst & Young)
2008 – Ben McVicar (Credit Suisse), Matthew Thorne (Credit Suisse)
2007 – Sam Turner (ABN Amro Morgans)
2006 – Paul Tacon (PhD, UQ), Ravi Jeyaraj (Navis Capital), Thomas Green (Crescent Capital), Alexander Pascal-Bossy (Macquarie)
2005 – Angela Gill (Wilson HTM), Andrew Wagner (Macquarie)
2004 – Matthew Tochterman (M. Fin. Eng., UC Berkeley), Justyna Lewandowska (JP Morgan), An Pham (UBS)
Masters (2 students)
2003 – Scott Francis (A Clear Direction Financial Planning), Hernando Barrero (PricewaterhouseCoopers)

PhD reader

Damien Cannavan 2012

Teaching

UQ Business School, The University of Queensland (Mean teacher ratings out of a possible 5.0)

Awarded undergraduate teaching prize 2009
Empirical Finance Honours (2009-12; PhD and Honours students; avg. rating 4.1)
Corporate Finance Honours (2005 & 2011; PhD and Honours students; avg. rating 4.7)
Investments & Portfolio Management (2002-7, 2009-10 & 2012; B.Com, MBA & M.Com students; avg. rating 3.8)
Corporate Finance (2002-4, 2006-10 & 2012; B.Com, MBA and M.Com students; avg. rating 3.8)
Finance (2005-6; M.Com students; avg. rating 3.7)
Corporate Finance and Investments (Mt Eliza Business School, Beijing 2003; MBA students)
Technology Valuation and Project Evaluation (Singapore 2004; Masters of Technology Management students)
Auditing (Summer 2000/1-2001/2; B.Com, MBA and M.Com students; avg. rating 3.8)

Ross School of Business, The University of Michigan

Corporate Financial Policy (2008; MBA students; avg. rating 4.3)

Executive education

Risk Management and Financial Analysis (Rabobank 2000-10)
Financial Analysis of Innovative Investments (UQ Business School 2007)
Credit Analysis (Queensland Treasury Corporation 2005)
Capital Management (UQ Business School 2004)
Making Critical Financial Decisions (UQ Business School 2003)
Business Valuation and Analysis (UQ Business School 2003)
Cost of Capital Estimation (UQ Business School 2003)
Analysis of Real Options (Queensland Treasury 2003)

Student competitions

Rotman International Trading Competition

Manager of the UQ Business School trading team (2007 & 2009-12) which competes annually at the University of Toronto amongst 50 teams. UQ is the 9th most successful entrant from 66 schools which have competed in any of the same years, finishing 3rd in 2010, 6th in 2007, 11th in 2009, 14th in 2011 and 18th in 2012.

UBS Investment Banking Competition

Judge for the UQ section 2006-7 & 2009-12. Faculty representative at the national section 2008.

JP Morgan Deal Competition

Judge for the UQ section 2007-8.

Wilson HTM Research Report Competition

Delivered two workshops as part of the 2006 competition and was one of three judges.

Industry engagement

From 2000-12, I have provided consulting services as part of SFG Consulting and UQBS Commercial. Services have been provided in conjunction with Frontier Economics, ARENA Consulting, Parsons Brinckerhoff and Uniquest.

Retail electricity and gas margins in NSW (Independent Pricing and Regulatory Tribunal 2012)

In 2006-7 and 2009-10 I acted as part of a team which was engaged to estimate electricity costs and margins for electricity and gas retailers in NSW. We have been reappointed for 2012-13. My role related to the estimation of a profit margin which would allow the retailer to earn a return commensurate its systematic risk. The approach developed was novel in that the margin was derived without reference to any pre-defined estimate of the asset base. Rather, the margin was a function of the potential increases or decreases in cash flows which would result from changes in economic conditions. Reports are available from IPART.

Advice on rules to determine regulated rates of return (Australian Energy Markets Commission 2012)

The AEMC is considering changes to the rules relating to regulation of electricity and gas networks. Independent rule change proposals have been put forward by the Australian Energy Regulator and the Energy Users Association of Australia. Both groups argue that application of the existing rules by the regulator generate upwardly-biased estimates of the regulated rate of return. As part of a team I am currently providing advice to the commission on whether the rule change proposals provide evidence on an upward bias, and if so, whether the proposed amendments are likely to reduce the extent of any bias.

Expert evidence relating to regulated rates of return (Electricity network businesses 2011)

In April 2011 the Australian Competition Tribunal heard an appeal by electricity networks on the regulated rate of return set by the Australian Energy Regulator. The issue was the value of dividend imputation tax credits. The Tribunal directed us to perform a dividend drop-off study to estimate the value of a distributed credit. Largely on the basis of our evidence the Tribunal determined that an appropriate value for a distributed credit was 35 per cent of face value. The Tribunal determination is available on its website and our expert report is available on request.

Estimation of risks associated with long-term generation contracts (New South Wales Treasury 2010)
In 2010 the NSW Government privatised a segment of its electricity industry, by selling three electricity retailers and entering into two generation agreements termed GenTrader contracts. The state-owned generators agreed to provide generation capacity in exchange for a charge. The generators also agreed to pay penalties in the event that their availability was less than agreed. As part of a team, I provided advice to NSW Treasury on the risks associated with the contracts. The estimated penalties resulting from this analysis are used by NSW Treasury in their budgeting role and in providing forward-looking analysis to the Government.

Litigation support relating to asset valuation (Alcan 2006-7)
In 2006-7 I acted as part of a team which provided litigation support to Alcan in a dispute with the taxation authority in the Northern Territory. The dispute related to whether Alcan was required to pay stamp duty as a result of its acquisition of an additional 30 per cent interest in Gove Alumina Limited. One issue was whether the acquisition was land-rich, meaning that the proportion of the asset considered to be land exceeded a threshold triggering stamp duty.

Methodology for evaluating public-private partnerships (Queensland Treasury Corporation 2005)
In 2005 I acted as part of a team which advised QTC on evaluating public-private partnerships, which typically require subsidies to appeal to the private sector. We rebutted the conventional wisdom, adopted in NSW and Victoria, that the standard valuation approach is flawed for negative-NPV projects. Furthermore, we developed a technique to incorporate systematic risk directly into expected cash flows, which are then discounted at the risk-free rate.

Litigation support
Insolvency proceedings relating to the collapse of Octaviar (Public Trustee of Queensland 2008-9)
Valuation of resource assets (Compass Resources 2007-8, Westpac Banking Corporation 2007)
Appeals against regulatory determinations (Envestra 2007-8, Telstra 2008)
Advice on whether loan repayments correspond to contract terms (Qld Dept. of Fair Trading 2005)
Advice on whether port and channel assets were contributed and hence not part of regulated assets (Comalco 2004-5)

Valuation
Management performance securities (Collins Foods Group 2006-11, GroundProbe 2008-9)
Ordinary shares in the context of an equity raising (Auscript 2007-8)
Intangible assets (Inbartec 2007)
Resources assets (Senex Energy 2012, Chalco 2007, Bank of Queensland 2007)

Cost of capital estimation, advice and regulatory submissions
Transport (Qantas 2008, QR National 2005 & 2012)
Water (Essential Services Commission of South Australia 2012, ActewAGL 2012, IPART 2011, Metropolitan utilities in Victoria 2004 & 2006-7, QCA 2002-3)
Energy networks (Economic Regulation Authority in Western Australia 2009, Hong Kong Electric 2007, Envestra 2006-7 & 2012, Powercor 2005, AGL 2004, Energex 2003-4, Ergon Energy 2003-4)
Local government networks (Queensland Competition Authority 2009)
Electricity generation (National Generators Forum 2008)
Environmental consulting (Ecowise 2007)
Listed vs unlisted infrastructure funds across alternative European equity markets (ABN AMRO Rothschild 2007)
Forestry assets (Queensland Department of Natural Resources 2004)

Portfolio performance measurement
Performance evaluation and benchmark derivation (Friday Investments 2010-12, Zupp Property Group 2011-12)

Corporate finance
Economic impact assessment of a proposed development of a retail shopping complex (Lend Lease 2006)
Impact of an acquisition on dividend growth, earnings per share and share price (AGL 2003-4)
Estimation of the optimal capital structure for electricity generation and distribution (NSW Treasury 2001-2)
Review of the debt valuation model used by the Snowy Hydroelectric Authority (NSW Treasury 2002)
Estimation of the optimal contract terms for coal sales to an electricity generator (NSW Treasury 2001-2)

Econometrics
Scoping study into the determinants of changes in tax debt in Australia (Australian Taxation Office 2007)

Interests

I am interested in sport as a participant and spectator. I finished 3rd on three occasions in the Brisbane Half Marathon (2005 & 2009-10), 8th in the Toronto Half Marathon (2002) and 3rd in the Australian Universities Marathon Championships (2003). I have finished 17 marathons, recording a best time of 2:47:54 in the Chicago Marathon 2011. From 1994-96 I was a member of The University of Queensland tennis team, which placed 1st at the Australian University Games in 1994.