Alternative approaches to the determination of the cost of equity

Other Industries — Discussion Paper
November 2009
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Invitation for submissions

IPART invites written comment on this document and encourages all interested parties to provide submissions addressing the matters discussed.

Submissions are due by 23 December 2009.

We would prefer to receive them by email WACC@ipart.nsw.gov.au.

You can also send comments by fax to (02) 9290 2061, or by mail to:

Alternative approaches to the determination of the cost of capital
Independent Pricing and Regulatory Tribunal
PO Box Q290
QVB Post Office  NSW  1230

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We may choose not to publish a submission—for example, if it contains confidential or commercially sensitive information. If your submission contains information that you do not wish to be publicly disclosed, please indicate this clearly at the time of making the submission. IPART will then make every effort to protect that information, but it could be subject to appeal under freedom of information legislation.

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1 Introduction

IPART is currently undertaking a review of the way that it estimates the return on capital as part of its regulatory decisions. As part of this, we have released a number of discussion papers on specific aspects of the weighted average cost of capital (WACC). This discussion paper continues this theme, considering alternative approaches to estimating the costs of equity that could be used instead of the standard capital asset pricing model (CAPM) we currently use.

In some industries the cost of capital may represent up to 50% of the total revenue requirement. We recognise that any change to the way we calculate the cost of equity may have substantial financial impacts on regulated businesses.

At the outset, we think it is important to state that we are not inclined to change from using CAPM. However, we believe that it is important to seek stakeholder comments on the alternative models available given that there recently has been a lively discussion on what the appropriate model to estimate the cost of equity is.¹

This paper reviews alternative cost of equity models which may in some instances provide a more accurate estimate of the cost of equity. However, these models are not always implementable in the Australian context where limited financial market data on utilities is available.

We also believe that there is a material difference on how financial markets use the cost of equity and how regulators do. Financial market analysts use CAPM to estimate a cost of equity specific to a company in order to estimate its value or provide a cross-check. Regulators, on the other hand, aim to ensure a predictable regulatory environment that will facilitate investment in the medium to long term. Under incentive-based regulation the regulator wishes to establish prices using an average or typical return for the sector. Depending on whether a particular business can beat the benchmark industry costs used by the regulator, its actual return on equity will be higher or lower than the industry average.

1.1 IPART’s current approach to estimating the WACC

The assets of the utility are financed by either debt or equity (funds contributed by the owner). ‘Equity’ refers to funds raised from the owners of the business, the shareholders. ‘Debt’ refers to any borrowings of the regulated business.² The cost of each source of funding is the return required on each. The weighted average cost of capital (WACC) is the total of the return required by the two sources of funding, weighted by the proportion of each used by the business.

¹ See for example the AER review on the WACC for electricity transmission and distribution.
² In practice, sources of funding are more complicated that this distinction allows, with various possible forms of debt and equity that take on different parts of the risk of the underlying asset.
1.1.1 WACC parameters

The formula used to calculate the WACC is set out in Appendix A. In simple terms:

- The cost of debt is the debt margin plus the nominal risk-free rate.
- The cost of equity is required return by investors comprising a risk premium associated with the non-diversifiable (systematic) risk associated with a specific asset, firm or industry, plus the nominal risk-free rate. The cost of equity is calculated using the CAPM under which the risk margins depend on the extent of exposure.

1.1.2 Pre-tax real WACC or post-tax nominal WACC

The WACC can be calculated before or after tax, and can be expressed in real or nominal terms. Theoretically, the calculation of the WACC as pre-tax or post-tax should have little impact on the revenue outcome for the regulated business, provided the same tax rate is assumed. In a post tax approach, tax is modelled separately as another cost item.

IPART has used the statutory tax rate of 30% in all previous determinations.

1.2 The regulated industries for which IPART estimates the WACC

We currently calculate the WACC for a range of regulated businesses in different industries. The regulated sectors and businesses covered include:

- Water providers such as Sydney Water, Hunter Water, State Water and Sydney Catchment Authority.
- Transport providers such as CityRail, bus operators, ferry operators, taxis and freight rail operators.
- Other industries such as retail electricity and one-off reviews.

Our WACC applies for the length of a regulatory period, which generally is 4 years.

1.3 The objectives of setting the WACC

In setting prices regulators wish to provide for a commercially sustainable cost of capital to:

1. ensure prices reflect the true costs of the services provided
2. send the correct signal to facilitate efficient investment in new assets and
3. remunerate existing assets.
A higher WACC is an incentive for greater investment by regulated businesses but it also results in prices that exceed the true cost of supply. Hence, it can discourage customers from using the service even when they and society would be better off if they did. A lower WACC will discourage investment. In this case, prices will be below cost, discourage investment in new capacity and encourage overuse of the service. This may result in capacity shortages and supply interruptions that can impose high costs on the community. By setting a WACC that is equal to that required by the market, regulators are aiming for an investment level that is economically efficient, and prices that properly signal costs to customers.

There are two additional considerations that impinge on the incentive effects of the WACC.

Firstly, the cost of capital could be different for different projects or different parts of a regulated business. In this case, setting a single WACC could encourage greater investment in low risk, low return activities and lesser investment in high risk, high return activities.

Secondly, the broader regulatory framework can significantly change the incentive effects for investment. The building blocks approach used for many regulated businesses allows expected capital expenditure to be incorporated into prices. During the regulatory period the regulated business benefits from any reduction in costs. This is intended to promote efficiency, but may act as a disincentive to prudent investment.

1.4 The need for review

In common with most regulators using incentive-based regulation, we estimate an industry-specific cost of equity in our WACC decisions. This is intended to provide incentives for the business to optimise its financing strategies and financial management. We currently use the CAPM to estimate this cost of equity. The CAPM is widely used by regulators and financial market participants. However, the CAPM has been criticised for a number of its features. In particular:

- a mechanistically applied CAPM does not align with the use of this model by market practitioners
- the assumptions on which the CAPM is based are empirically unsound
- the theoretical relationships implied by the CAPM are difficult to discern in real world data
- the cost of equity estimate does not always align with investors’ expectations.

Despite these criticisms, the CAPM remains the dominant model used by regulators and market practitioners and at this stage we do not wish to change from the CAPM model. However, given these criticisms, we believe that it is good practice to periodically review our methods.
1.5 Alternatives to the CAPM

The alternatives considered in this issues paper are:

- The CAPM.
- The Dividend Growth Model (DGM) — under this model the cost of equity can be calculated from the current value of traded assets and the expected dividends arising from the assets.
- Multi-factor pricing models\(^3\) such as the Arbitrage Pricing Theory and the Fama French Model that include additional explanatory factors of the returns required by investors.
- Extensions to the CAPM that relax particular assumptions.

This issues paper also discusses alternative ways of implementing the standard CAPM, such as allowing for a wider cross-section of assets (types of assets or international assets).

1.6 Timetable

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 November 2009</td>
<td>Release of discussion paper</td>
</tr>
<tr>
<td>23 December 2009</td>
<td>Submissions on discussion paper due</td>
</tr>
<tr>
<td>March 2010</td>
<td>Release of final decision</td>
</tr>
</tbody>
</table>

1.7 Issues on which IPART particularly seeks comment

1. For what reasons is the CAPM the dominant model for regulators and market practitioners? Does this reflect the perception that the use of the CAPM will provide the closest measure of the actual cost of equity required by the market?

2. Should IPART consider any alternative approaches for estimating the weighted average cost of capital and cost of equity? Should these approaches be used only as a cross-check on the CAPM? How much weight should be given to these approaches?

3. Do the alternative approaches better align the cost of equity set by the regulator with the cost of equity required by the market?

4. Will the different approaches impact on the incentives facing regulated businesses?

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\(^3\) Multi-factor models are similar to the CAPM but they use more inputs and thus are able to capture more determinants of the cost of equity.
1.8 The structure of this paper

This paper begins with some background information on setting the WACC for regulated businesses and the need for review of the method for estimating the cost of equity in particular.

Chapter 2 outlines the objectives and assessment criteria used by IPART in evaluating the appropriateness of a cost of equity model.

Chapter 3 summarises our current approach to estimating the cost of equity and Chapter 4 discusses how the cost of equity is estimated elsewhere, in financial markets and by other regulators.

The second part of this paper is more technical and some readers may be satisfied by reading the summary section at the start of each chapter.

Chapter 5 discusses the CAPM and chapter 6 introduces the various alternative cost of equity models.

Chapter 6 outlines the possible future directions we could take to estimate the cost of equity.

2 Objectives and assessment criteria

In our WACC decisions, we set a WACC for an industry and not for a particular business. For example, when setting the WACC for metropolitan water agencies, the WACC is estimated for the urban water and sanitation industry and not for Sydney Water or Hunter Water as individual businesses. This ensures that all businesses operate under the same incentives.

2.1 Objectives in setting the WACC

We consider that the cost of capital used in making regulatory determinations should reflect the commercial cost of capital for a similar, well-managed, privately owned business. This will lead to efficient investments and ensure best possible prices which fully reflect the efficient cost of providing the service. In practice, this means that we are setting prices that reflect the true cost of providing a particular service, regardless of whether a utility is owned by the public or the private sector.

IPART’s main objectives in setting the cost of equity are:

- it is determined for an industry and is not business-specific
- it is a commercial cost
- it is consistent with market conditions and
it is transparent and can be replicated.

These objectives ensure that the full commercial cost of providing a service is determined in a transparent way.

2.2 Criteria for assessing options

Taking into account the objectives set out in the previous section, we believe that the assessment criteria set out below are important in the determination of the relevance of a cost of equity model to the regulatory context in which IPART operates.

2.3 Consistency with market expectations

The cost of equity model must result in a cost of equity that is commensurate with prevailing market conditions.

Why does this matter to us?

We want to ensure that the true cost of providing a service is reflected in its price. This includes the cost of equity. We want to ensure that the cost of equity reflects the commercial cost in financial markets regardless of whether a business is privately owned or is a government enterprise.

How are we assessing it?

In the case of the cost of equity model, we have to ensure that all the inputs into the model are obtainable from publicly available sources. In addition, these sources must reflect current market data.

2.3.2 Practicality of implementation

The cost of equity model must be implementable. By this we mean that any model used by the regulator must be replicable by stakeholders.

Why does this matter to us?

This is good regulatory practice. If a model is not replicable by stakeholders, we would be using a “black box” approach in determining the cost of equity. We want to avoid this as it is important to us that all stakeholders can fully understand how the cost of equity is calculated.
How are we assessing it?

We must be convinced that all the inputs into a model are transparent – this means that any particular input into a model means the same thing to all stakeholders. This is not always obvious as some of the cost of equity models leave it up to the user to define certain inputs.

2.3.3 Consistency of approach

The model used to estimate the cost of equity must be consistent with the models used to determine the other WACC inputs. This is not always obvious as the CAPM draws a clear distinction between business specific and non-business specific risk. Changing to a model that would allow the inclusion of business specific risk in the cost of equity would open the debate for changing any of the other WACC parameters in order to avoid double counting of risks.

Why does this matter to us?

The importance of consistency of approach may not be obvious. The CAPM draws a clear distinction between business specific and non-business-specific risk. Changing to a model that would allow the inclusion of business-specific risk in the cost of equity would imply that we have to re-assess the way we estimate other parameters to avoid double counting.

How are we assessing it?

We are looking at what types of risk are priced into a particular model and then comparing it to the CAPM.

2.3.4 Transparency

We aim to deliver transparent decisions. This means that all the input data we are using should be readily available to all stakeholders.

Why does this matter to us?

We are making decisions that affect everybody in NSW. In making a decision we must ensure that anybody, regardless of whether they are a government department, a business or an individual, can access the information we used in coming to a decision.
How are we assessing it?

The inputs into the cost of equity model must be clearly defined and be available to all stakeholders. In the case where we have to use subscription services to obtain data we will keep a record of this data.

3 Current approach

IPART currently uses a standard CAPM to estimate the cost of equity as part of its calculation of the weighted average cost of capital. This involves estimating individual parameters for the particular business, as well as market parameters that would be the same for all business.

This chapter sets out the current approach to estimating the cost of equity in detail.

3.1 CAPM and cost of equity

This issues paper focuses on the cost of (or return on) equity ($R_e$). Under CAPM the expected return on equity is the total of the risk-free rate and a risk allowance. The risk allowance is calculated as a proportion of the average risk premium for all investments. Algebraically it is:

$$R_e = R_f + \beta_e \cdot (E[R_m] - R_f)$$

*Where:*

- $R_e$ is the return on equity
- $R_f$ is the risk-free rate
- $\beta_e$ is the equity beta
- $(E[R_m] - R_f)$ is the market risk premium (MRP).

The size of the risk premium for a business depends on the extent of covariation of returns on its stock with that on the market. For businesses with shares traded on the stock market, $\beta$ is a measure of systematic risk calculated as the correlation of returns on the firm’s stock and that on the market overall, divided by the variance of returns on the market. The risk premium for the stock (the return required in excess of the risk-free rate) is given by $\beta (E[R_m] - R_f)$. If it is less volatile $\beta$ will be less than 1 and the risk premium will be less than the market average.

In implementing the CAPM, IPART assesses the risk-free rate, equity beta and MRP. We currently estimate these parameters through a defined ‘market’ portfolio of equity in listed Australian companies.
3.2  Past decisions on CAPM parameters

IPART’s past decisions on the parameters relevant for the CAPM and cost of equity are shown in Table 3.1. In the past, IPART has consistently applied a MRP in the range from 5.0% to 6.5%, with the lower limit being 5.5% for more recent decisions. IPART has applied an equity beta that is very similar for all the businesses that it regulates — of 0.8 to 1.0 at a gearing ratio of 60%.

Table 3.1  IPART’s past decisions on CAPM parameters

<table>
<thead>
<tr>
<th>Determination</th>
<th>MRP (%)</th>
<th>Equity beta</th>
<th>Debt to total value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Hunter Valley Coal Network (2009)</td>
<td>5.5</td>
<td>6.5</td>
<td>0.7</td>
</tr>
<tr>
<td>CityRail (2008)</td>
<td>5.5</td>
<td>6.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Metropolitan Water (2008)</td>
<td>5.5</td>
<td>6.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Retail electricity (2007)</td>
<td>5.5</td>
<td>6.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Bulk Water (2006)</td>
<td>5.5</td>
<td>6.5</td>
<td>0.8</td>
</tr>
<tr>
<td>AGL Gas Networks (2005)</td>
<td>5.5</td>
<td>6.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Country Energy Gas Networks (2005)</td>
<td>6.0</td>
<td>6.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Metropolitan Water (2005)</td>
<td>5.5</td>
<td>6.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Electricity distribution (2004)</td>
<td>5.0</td>
<td>6.0</td>
<td>0.78</td>
</tr>
<tr>
<td>Metropolitan Water (2003)</td>
<td>5.0</td>
<td>6.0</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Source: IPART final determinations (various).
3.3 Role of subjective judgement

IPART retains a role for exercising its regulatory judgement in choosing within the estimated WACC range. In choosing within the range, we consider:

- the requirements of the IPART Act
- the likely costs of setting a WACC that is too high versus too low
- evidence about whether each parameter is towards the upper or lower end of their range
- the broader market conditions facing the business.

This has meant that IPART has set a WACC above the mid-point of the range for some reviews and below the mid-point of the range for others. This flexibility has in the past allowed IPART to take into consideration issues that do not fit neatly within a mechanistically applied CAPM for the cost of equity. For example, in its 2009 decision on the rail access rate of return, we used a WACC above the midpoint because this rate of return strikes the right balance between the risks involved, including what IPART considers to be the considerable risks associated with underinvestment in the network.

4 Models used in practice

This chapter sets out the models used by Australian regulators, overseas regulators and market practitioners. The CAPM is the most used model, although alternative models, in particular the DGM, are sometimes used to cross-check estimates from the standard CAPM.

4.1 Australian regulators

All Australian regulators currently use the CAPM. A number of regulators have reviewed their use of the CAPM, for the reasons outlined at 1.4 above. To date, all regulatory reviews have found that the CAPM is the preferred approach theoretically and practically.

The reviews undertaken by Australian regulators are discussed in more detail below.

4.1.1 Australian Energy Regulator (AER)

The Australian Energy Regulator (AER) regulates gas and electricity transmission and distribution assets. An important component of this regulation is the return on capital, as these businesses are very capital intensive.
Under the National Electricity Legislation, the AER is required to use the CAPM to calculate the weighted average cost of capital. Nevertheless, in its recent review of the weighted average cost of capital for electricity transmission and distribution businesses, there was discussion about the strengths and weaknesses of the CAPM and the approach to estimating the cost of capital. The AER concluded that the standard CAPM was a reasonable predictor of equity returns although it is not without limitations.

In using the standard CAPM, the AER used a domestic market framework. The AER noted that foreign investors in the Australian market will be recognised in defining the representative investor, but only to the extent they invest in the domestic capital market.

The AER also considered alternative approaches to estimating the MRP such as historical estimates, estimates based on the dividend growth model and surveys of market practitioners.4

The AER’s conclusions were that:

- Current market conditions likely reflected either that the prevailing medium term MRP is above the long term MRP but will return to the long term MRP over time or that there has been a structural break in the MRP
- To reflect current market conditions, the AER allowed an increase in the MRP from 6% to 6.5%.

In making this decision, AER continued to place primary weight on long term historical estimates. The 0.5% increase in the MRP in response to market conditions following the global financial crisis reflected that the AER placed some weight on estimates from the dividend growth model, which suggested a MRP well above 6%.

### 4.1.2 Australian Competition and Consumer Commission (ACCC)

The ACCC sets a weighted average cost of capital for telecommunications assets, rail assets and postal services. In doing this, it typically uses a CAPM approach.5

In reviews currently under way, such as the 2009 review of prices for Australia Post, regulated businesses have submitted information suggesting the current MRP is higher than the historical average. This analysis is based on alternative models such as the dividend growth model and measures based on options volatility and the debt premium.6 The ACCC is yet to assess the merit of these arguments.

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At its 2008 Conference, the ACCC hosted a session on “The CAPM - should regulators be looking at alternatives?” The speakers at this session noted the dominant role played by the CAPM, but also that there are implementation issues for particular types of businesses:

▼ Kevin Davis noted that there were better theoretical models than the CAPM such as generalised versions of the CAPM and forward-looking models. However, these models may not be better in practice for regulatory purposes. Davis also noted implementation issues with the way that the CAPM is currently used which could be corrected. These included ensuring that building block applications calculated expected cash flows rather than expected cash flows given success. This is analogous to a real options approach to the building blocks.7

▼ Ravi Jagannathan noted that the CAPM may perform better than the empirical evidence suggests, particularly when applied to projects rather than firms. He suggests that the empirical evidence is not sufficient to replace the CAPM with an alternative model.8

4.1.3 Queensland Competition Authority (QCA)

The QCA contracted Professor Martin Lally to provide advice on the methods used to estimate the cost of capital in 2004.9 He concluded that:

▼ The advantages of the CAPM relative to other models outweigh its disadvantages and the QCA should continue to use a version of the CAPM.

▼ The appropriate version of the CAPM accounts for tax implications arising from dividend imputation and capital gains tax.10

4.1.4 Other regulators

Other Australian regulators all use the CAPM. Alternative models have not been reviewed in any detail. This appears to have largely reflected that the CAPM is widely used and understood by market practitioners and regulatory stakeholders and is the model proposed by regulated businesses.11

10 Note this is a somewhat different version than the Officer version adopted by IPART that only allows for imputation credits. We do not use capital gains tax in our financial model.
4.2 Overseas regulators

Methods other than the CAPM are used much more by UK and US regulators than Australian regulators, although often as a cross-check for estimates based on CAPM. The cost of equity allowed by regulators in the UK and US is also lower than allowed by Australian regulators, on average (see Box 4.1). This section discusses the approaches taken by overseas regulators.

Box 4.1 Cost of Equity in the UK, US and Australia

In 2001, NERA compared the cost of equity allowed by regulators in North America, the UK and Australia, based on regulatory decisions from 1995 to 2000. They found that the cost of equity allowed in Australia averaged 10.1 per cent, compared to 8.8 per cent in North America and 6.9 per cent in the UK.

Some of these differences in the cost of equity reflect different market conditions and regulated businesses. It is plausible that the different outcomes are also driven by different methods for estimating the cost of equity.

NERA (2001), International Comparison of Utilities’ Regulated Post Tax Rates of Return in: North America, the UK and Australia, prepared for the ACCC, March, p 3.

4.2.1 UK regulators

UK regulators typically use the standard CAPM, supplemented by estimates based on the dividend growth model. There has been extensive research in the UK into the alternative models, which is summarised below.

Smithers and Co

In 2003, the UK regulators jointly commissioned a report on the cost of capital undertaken by Smithers and Co. The report provides a comprehensive analysis of the issues surrounding estimation of the cost of capital in the UK and recommendations that have largely been adopted by UK regulators. Smithers and Co undertook follow up work in 2006 for OFGEM, the UK regulator for electricity and gas.
As part of their work, Smithers and Co reviewed alternative models to the CAPM. Some key points from this analysis are set out below.

- The standard CAPM has considerable empirical shortcomings but has clear theoretical foundations and is widely used.

- The majority of alternative models to the CAPM propose additional factors aside from systematic risk that could influence required returns. In general, these models suffer from issues of data mining, over fitting and a lack of clear economic logic. While they can perform better than the standard CAPM for a particular period in-sample, they have less value out of sample.

- Estimates of the UK long-run equity risk premium from the dividend growth model (or dividend discount model) are similar to those from long-run historical averages. They note that there are significant difficulties associated with using the DGM on a forward looking basis. These include the possibility of negative MRP and the impact of temporary share market fluctuations (such as bubbles).

- There is no one clear successor to the CAPM.

- Estimation of equity beta should consider international assets and non-equity assets. They propose a practical way for doing this for the UK is to assess the portfolio of a ‘typical UK investor’. They consider that the portfolio of a typical UK investor could be proxied by either:
  - 50% UK equity index, 20% UK government bonds, 10% overseas bonds and 20% world share index (converted into pounds sterling)
  - 70% UK equity index and 30% world share index (converted into pounds sterling)

In their 2006 report, Smithers and Co analysed data for listed regulated UK electricity network companies. The results from this analysis confirmed their previous report, in particular showing that the statistical evidence for the use of the Fama French 3 factor model was weak. The maximum increase in the cost of equity arising through the Fama French factors for the regulated electricity network businesses was 1.25%.

**OFWAT**

OFWAT, the regulator for water and sewerage businesses in the UK, has recently released its draft report for prices for water and sewerage from 2010 to 2015. In this report, OFWAT based its estimates of the WACC on the CAPM, while also considering estimates of the cost of equity that use the dividend growth model.

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12 Smithers and Co note that this approach is not consistent with CAPM assumptions that all agents hold all risky assets in equal proportions (Smithers and Co 2003, *A study into certain aspects of the cost of capital for regulated utilities in the UK*, February, pp 96-97).
OFRWAT’s consultant also assessed other methodologies such as the Fama and French model, the dividend growth model, the market to book values and discussions with market practitioners.

Analysis undertaken on behalf of the water businesses placed weight on both the CAPM and DGM estimates of the cost of equity. DGM estimates were considered as a cross-check on traditional CAPM measures.

**OFGEM**

OFGEM is the UK regulator for gas and electricity businesses. The OFGEM approach broadly adopts the recommendations of Smithers and Co (2003, 2006).

In its background paper for the review of electricity distribution prices for 2005 to 2010, OFGEM calculated the cost of equity using both the CAPM and the DGM. DGM were considered as a cross-check to CAPM estimates. In using the DGM it assumed growth in line with demand forecasts or historical dividends.

**OFCOM**

OFCOM regulates prices for some telecommunications services, for which it has to calculate a WACC. In 2005, OFCOM undertook a review of its approach to the cost of capital. In its final statement, OFCOM noted:

- The standard CAPM would form the basis of its estimates of the cost of capital for regulated telecommunications businesses.
- OFCOM had an extended discussion on the use of real options for regulated businesses, although noting that there was no practical way of incorporating real options into its regulatory decisions. It viewed real options approaches as becoming more attractive when there was significant demand or technology risk, when investments were largely sunk and in the absence of a first mover advantage.

**UK Competition Commission**

The UK Competition Commission (CC) provides advice to the British Airports Authority on the regulation of airports, and settles certain categories of dispute on regulatory determinations.

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In its 2007 report on UK airports, the CC used the standard CAPM as the basis of its analysis but considered forward looking estimates of the MRP using the dividend growth model.\textsuperscript{17} In making its recommendations, the CC noted that:

\begin{itemize}
  \item the CAPM was the tool with the strongest theoretical underpinnings
  \item it is not clear that other models have better predictive power for UK companies
  \item none of the alternative models helped resolve particular issues with the review (such as that British Airports was no longer listed on the stock exchange).
\end{itemize}

In considering the dividend growth model, the CC used this as an alternative way to extract long-run estimates of the MRP, rather than a tool for estimating short-term changes in the MRP. The estimated long run MRP for the UK from the DGM was noted to be lower than that from historical estimates, as historical returns had generally exceeded expectations over the 1950 to 2000 period.

The CC also considered the MRP assumptions used by pension funds in making their assets and liabilities.

The CC’s final estimate of the MRP was a range of 2.5\% to 4.5\%, with the lower end representing long-run evidence from ex ante measures (the DGM) and the higher estimate from ex post measures (historical returns).

\textbf{CAA}

The Civil Aviation Authority (CAA) is the regulator of UK airports. It determines a WACC for UK airports, based on the recommendations of the CC (as noted above). The CAA and CC’s conclusions are very similar so they are not discussed in detail here.

\textbf{ORR}

The Office of Rail Regulation (ORR) is the UK regulator of rail. They use the standard CAPM approach to estimating the cost of equity.

\textsuperscript{17} UK Competition Commission 2007, \textit{BAA Ltd: A report on the economic regulation of the London airport companies}, September, p F3.
4.2.2 US regulators

In the United States, state and federal regulators determine the cost of equity so as to provide a ‘fair and reasonable’ return on capital investments. The method used to determine fair cost of equity is somewhat different to the approach taken in Australia (and the UK). The US typically relies upon the DGM, also known as the discounted cash flow (DCF) method, to estimate the cost of equity (referred to as return on equity (ROE) in the US), with the CAPM sometimes used as a cross-check.

The DGM relies upon the estimation of the yield (dividend yield with respect to stock price) and a growth factor. While the conceptual simplicity of this approach is an attractive element of this method, estimating the cost of equity for private companies using the DGM can be challenging. To get around this, publicly available estimates of utility growth are combined with proxy groups – similar risk firms – to estimate the growth rate, and determine the cost of equity.

Table 4.1 reports the regulatory approaches and outcomes for regulated energy businesses from 1999 to 2003. This table shows that the DGM is the predominant tool used to determine the cost of equity.

Table 4.1 Cost of equity allowances: US Energy decisions

<table>
<thead>
<tr>
<th>Decision</th>
<th>Approach</th>
<th>Rate adopted</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW Natural Gas (Oregon) November 1999</td>
<td>DCF and CAPM</td>
<td>10.25%</td>
</tr>
<tr>
<td>Pacificorp (Utah) June 2000</td>
<td>DCF and risk premium</td>
<td>11.00%</td>
</tr>
<tr>
<td>Fitchbury (Mass) October 2001</td>
<td>Predominant DCF</td>
<td>10.50%</td>
</tr>
<tr>
<td>CNG and Southern Gas (Conn) February 2002</td>
<td>Risk Premium</td>
<td>10.71%</td>
</tr>
</tbody>
</table>
| PG&E, SCE, Sierra, SGD&E (CPUC) November 2002 | Many methods | 10.9–11.60%
| Questar Gas (Utah) December 2002 | DCF | 11.20% |
| Colorado Public Service Co gas and electricity May 2003 | DCF | 10.75–11% |
| Aquila (Colorado) June 2003 | DCF | 10.75% |


Despite the uncertainties associated with constructing the parameters for the DGM, the estimated cost of equity for the businesses shown in Table 4.1 has been remarkably consistent across sectors (and through time). The nominal cost of equity has varied between a minimum of 10.25 and 11.60 over the 4-year period from 1999 through to 2003. It is also notable that cost of equity decisions appear to be less affected by changes in the risk-free rate than would be the case under a CAPM methodology.

The CAPM is used in the US in conjunction with other methods for estimating the cost of capital. For instance, the Texas Public Utility Commission used the CAPM to adjust the cost of equity to a different capital structure than that currently used by regulated electricity distributors.20

US regulators have adopted earnings sharing mechanisms that limit the negative consequences of errors in estimating the cost of equity.21

### 4.3 Market practitioners

There have been a number of surveys of the use of different models to calculate the cost of equity both in Australia and internationally. These studies highlight the overwhelming dominance of the CAPM as the model of choice by financial practitioners.

- A 2004 survey of Australian corporate finance practitioners (capturing 87 firms) found that the CAPM was the most widely used model, being used by 72% of respondents. Almost half of respondents used a cost of debt plus a premium for equity to estimate the cost of equity22.

- A 2001 survey of 393 North American Chief Financial Officers (CFOS) found:
  - 27% of respondents indicated that they incorporated real options when evaluating a project (this was significantly lower for regulated than unregulated businesses)
  - 73% of respondents always or almost always used the CAPM to estimate the cost of equity capital, 34% used the CAPM but included additional risk factors and 16% used discounted dividend models


the main additional risk factors included other than market risk were, in order, interest rates, foreign exchange rates, GDP/business cycle, unexpected inflation, size and commodity prices (all of which were used by more than 30% of respondents who answered that they used additional risk factors)\(^\text{23}\)

\(^\text{23}\) A 2004 survey of the corporate finance practices of 313 European CFOs, comparable to Graham and Harvey’s (2001) survey of corporate finance practices in North America, found that around 50% of respondents used the CAPM and 15% to 30% of these included additional risk adjustments. The use of CAPM was lower in European countries than in the US. The survey found that smaller businesses were much less likely to use the CAPM than larger businesses.\(^\text{24}\)

\(^\text{24}\) A survey of 27 leading companies and 10 leading financial advisors in the US concluded that 80% of respondents used the CAPM, of which 85% to 90% used a standard version of the CAPM\(^\text{25}\)

\(^\text{25}\) A 2003 survey of 87 European companies found that 77% of respondents used the CAPM to estimate their cost of equity. The remaining firms used other undisclosed methods.\(^\text{26}\)

There is additional older survey evidence from Australia about corporate finance practices and the MRP assumptions used by businesses. This has been summarised in the AER’s final decision and is not reported in detail here.\(^\text{27}\)

IPART seeks comments on the following

1. For what reasons is the CAPM the dominant model for regulators and market practitioners? Does this reflect the perception that the use of the CAPM will provide the closest measure of the actual cost of equity required by the market?


\(^\text{27}\) AER (2009), *Review of the weighted average cost of capital for the electricity distribution network service providers*, p 221.
5 The CAPM model

The CAPM is the work horse model for Australian and international regulators and market practitioners. But it also has many critics. This chapter outlines the theoretical, empirical and practical requirements and limitations of the CAPM.

5.1 What is the CAPM and how is it used?

The CAPM is a model that describes the relationship between risk and expected return. While it has general application to all investments, it is most commonly used in the pricing of risky securities such as shares. The general idea behind CAPM is that investors need to be compensated for 2 factors:

- time value of money, and
- non-diversifiable risk.

The time value of money is represented by the risk-free rate in the formula and compensates the investors for placing money in a risk-free investment over a period of time. The other part of the formula represents the risk premium, or compensation, the investor needs for taking on risk (which cannot be costlessly diversified away). This is calculated by multiplying the risk measure (beta) by the market risk premium. The market risk premium is the return investors require to invest into the market relative to the risk-free rate.

The CAPM is widely used in financial markets, for example:

- by portfolio managers who have to decide which share to include in their investment portfolio, and
- by investment bankers to value takeover targets.

The CAPM has also been widely used by economic regulators, mainly because of its long standing acceptance in the market. It is also transparent as it relies on a few inputs that generally are directly observable in financial markets.

This is not to say that there are no problems with the CAPM. One of the most obvious issues with the CAPM is that it assumes that it is solely the level of risk that determines the required return on an investment. In the CAPM, this is represented in the term beta, which is a measure of systematic (or market) risk. This is the risk associated with aggregate market returns. Systematic risk is the risk of security that cannot be reduced through diversification. Hence, the larger the level of systematic risk (or the beta), the higher the required return.

On the other hand, the CAPM does not compensate investors for taking on any diversifiable risks.
The remainder of this section provides a more technical explanation of the CAPM and explains how the CAPM is applied in the regulatory context.

### 5.2 Introduction to the CAPM

The key postulate of the CAPM is the separation of systematic risk and non-systematic risk. Systematic risk includes events that impact on the overall market, such as the global financial crisis or an economic boom. Non-systematic risk includes events that impact only on a specific business and have no market-wide implications, such as Telstra’s exclusion from the National Broadband Network or the failure of a new product to attract demand.

The CAPM states that investors will require higher returns to invest in companies with greater systematic risk but will not require higher returns to invest in companies with greater business risk. This is because investors can construct portfolios that diversify away business risk but cannot do so for systematic risk. It does not require that all investors do diversify their portfolio, simply that some do. Returns above that warranted by systematic risks will be eroded as diversified investors look for value.

Under the assumptions of the CAPM, discussed in more detail in the next section, a linear relationship arises because investors are able to combine the market portfolio of risky assets together with positions in the risk-free asset to obtain an efficient portfolio of any desired systematic risk (Figure 5.1). The linear relationship arises because of the ability of investors to access a risk-free asset in unlimited supply.

**Figure 5.1 The CAPM risk-return frontier**

![The CAPM risk-return frontier](image)

**Source:** IPART.

The CAPM indicates that investors are willing to trade off risk and return to some degree.
5.3 Theoretical assumptions of the CAPM

The CAPM model is based on a number of important theoretical assumptions (see Box 5.1) about investors and assets.

Box 5.1 CAPM Assumptions

Callahan and Mohr (1989) summarise these assumptions as:

- Capital markets are perfect. This assumption implies that all market participants are price takers, information is costless and available to all, taxes and transaction costs are nonexistent, and capital assets are infinitely divisible.
- Market participants are single-period, risk-averse maximisers of the expected utility of their terminal wealth.
- Market participants have access to unlimited borrowing and lending at a risk-free rate.
- Investment decisions are based solely on the mean and standard deviation of each portfolio’s return distribution. This assumption implies either that investors’ utility functions are quadratic or that portfolio rates of return have a multivariate normal distribution.
- Investors have homogeneous beliefs with regard to the mean and standard deviation of each portfolio return distribution.
- All investors have the same planning horizon.\(^a\)


These assumptions are unlikely to hold in practice. But this is not surprising, since it should be remembered that CAPM is a simplified model of the real world, not the real world itself. More important than whether these assumptions hold perfectly in practice, is whether the simplifications of the model lead to significant, or potentially significant, errors in the estimation of the cost of equity.

5.4 Empirical validity of the CAPM

A number of the implications from CAPM can be tested empirically. For instance, assets with high systematic risk should, on average, have higher returns. However, it is worth noting that there is contention as to whether any empirical tests are valid. As Roll (1977) notes, it is impossible to determine whether tests of the CAPM fail because the CAPM is a poor model or because the portfolio used as the empirical proxy for the market portfolio is not the true market portfolio (for example if not all risky assets are included).\(^28\)

Fama and French (2004) put forward the negative case for the empirical validity of the CAPM. They conclude that the CAPM is invalid for the purposes for which it is used, given the empirical failing of key restrictions required by the model. They argue that it fails empirical tests in the following ways.

- The CAPM implies that no other variables should have explanatory power in explaining excess returns except for systematic risk. A substantial body of academic literature has identified additional variables that have explanatory power.

- The standard CAPM implies that assets that are uncorrelated with the market should earn a return equal to the risk-free rate. Empirical tests found returns from such assets were higher than the risk-free rate.

- Under the standard CAPM, there should be a positive linear relationship between estimated beta and returns. Empirical tests have found such a relationship, although it has been flatter than suggested by the standard CAPM.

The lack of empirical support for restrictions required by the CAPM is also noted by Smithers and Co (2003). These empirical results suggest that the CAPM is flawed as a basis for investor’s expectations of returns on their investment. This has been recognised in financial markets and many portfolio managers market their ability to be able to achieve a higher return on investment that what is implied by the CAPM. This excess return is commonly referred to as alpha.

The lack of empirical support for the CAPM has not undermined the importance of systematic risk as a determinant of future equity returns. For instance, Smithers and Co (2006) report findings of clear positive relationship between estimates of equity beta and average returns. This suggests that the central relationship posited by the CAPM may still hold, even if other aspects of the CAPM equation are incorrect (such as the risk-free rate).

The debate about the empirical support for the CAPM is not one-sided. For instance Da, Guo and Jagannathan (2009) conclude that “the empirical evidence is not sufficient to abandon the CAPM in favour of other models”.

In summary, the CAPM may not be the best model to forecast short-term movements in the cost of equity. However, in the medium and long-term it may be more reliable than other models, such as the dividend growth model.

30 Smithers and Co (2003), A study into certain aspects of the cost of capital for regulated utilities in the UK, February, pp 55-59.
5.5 Practical requirements for implementing the CAPM

Implementation of the CAPM requires estimates of the risk-free rate, MRP and equity beta. There are also additional implementation issues relating to how the cost of equity is applied within the regulatory framework.

Each of the parameters used in the CAPM is subject to uncertainty. Most significantly the equity beta and the market risk premium.

5.5.1 Estimation of CAPM parameters

The definition of the market

The CAPM specifies a relationship between an asset and the market as a whole. In implementing CAPM, the most important consideration relates to market definition. Figure 5.2 sets out the extent of asset types and locations captured in typical implementation of the CAPM.

Figure 5.2 Asset types

Most estimates of the MRP and equity betas use only listed equities. For Australia, listed equities in the ASX 200 have a market capitalisation of slightly over $800 billion, representing just 13% of Australia’s national wealth. The share of assets covered will be smaller than this once international investors and the investment of Australians in international markets are included.

The time period and frequency for estimation

For companies that are listed, equity betas can be calculated directly from a regression of company excess returns against market excess returns. In doing this, there are issues as to what frequency of data is used (daily, weekly or monthly) and over what time period the estimates are based (one year, two years or longer).

For IPART, the businesses we regulate are not listed. In this case, these issues are relevant for estimates of equity betas for comparator companies.

Type of estimation

Estimates of the equity beta for listed companies can use ordinary least squares (OLS) regression. Other estimation techniques use time-varying betas.

Finding comparable companies

The businesses that IPART regulates are not listed. In this case, equity betas are best estimated through considering comparator companies, either in Australia or overseas. In finding comparator companies it is important to be aware of the different regulatory rules facing the companies, the nature of the business undertaken and the leverage of the companies. Often it is difficult to find close comparators. For example, few water utilities are privately owned and those that are privately owned are often part of a more diversified company (eg, Veolia).

The MRP

There is a high degree of uncertainty inherent in the MRP estimate. We are using a range of 5.5% to 6.5% to account for the uncertainty that is inherent in the historical estimates of the MRP. For more information on our MRP estimate, please consult the discussion paper on IPART’s cost of capital after the AER’s WACC review34.

5.5.2 How does the CAPM measure up against our assessment criteria?

The CAPM is a relatively simple model. It has only three inputs, the risk-free rate, the equity beta and the market risk premium.

The CAPM is widely used in financial markets and, other things being equal, the CAPM delivers a cost of equity estimate consistent with market expectations. Compared to other models (see next chapter) it is easy to implement and any volatility in the estimate over time reflects prevailing market conditions. The CAPM is transparent albeit there are lively discussions around how some of the input parameters are estimated (equity beta and market risk premium).

34 Available on our website: www.ipart.nsw.gov.au
At this stage, we believe that the CAPM is still the best model to estimate the cost of equity in the regulatory context. It best meets our assessment criteria and is widely used in financial markets.

6 Alternative approaches

There are several weaknesses identified with the CAPM that continue to encourage the debate around the model used to determine the return on capital. This chapter sets out alternative approaches to estimating the cost of equity.

6.1 What alternative models are available and are they applicable in the regulatory context?

There are a number of models that are also used in the market albeit to a much lesser extent than the CAPM.

The Fama-French model builds on the CAPM by including two additional terms, the small size premium and the value premium. The small size premium accounts for the fact that smaller firms on average perform better than larger firms, at least in terms of expected growth. The value term is the difference between book value and market value and accounts for the fact that historically and on average, value shares\(^{35}\) have performed better than growth\(^{36}\) shares. This model has been adopted by some fund managers to account for the fact that the CAPM does not seem to be a good proxy for actual market returns.

The dividend growth model is a variant of the discounted cash flow model. The discounted cash flow model simply discounts all future cash flows of a business at the appropriate rate (usually the cost of capital) to determine the total value of a business. The dividend growth model simply uses a business’s dividend assuming that it will grow at a constant rate in the future and discounts this dividend by the cost of capital (less the growth rate). This model is used extensively but it assumes that the user knows the cost of capital. However, regulators can still use this model as a cross-check, for example by using the regulatory cost of capital and then applying the dividend growth model\(^{37}\).

Arbitrage pricing theory (APT) is another influential model in asset pricing. It differs from the CAPM in that it is less restrictive in its assumptions. It assumes that each investor holds a unique portfolio with its own particular set of risk measures as compared to the CAPM where the only risk is systematic risk. While this seems attractive, it introduces the difficulty that the user of the APT has to define which risk

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\(^{35}\) Value shares have high current earnings but may have low growth potential.

\(^{36}\) Growth shares have a higher future earning potential than the current earning.

\(^{37}\) For example in the UK the DGM is mainly used as an economy-wide check on the market risk premium, rather than for individual businesses.
factors are relevant for the investment. This introduces additional levels of judgement for the regulator and increases the risk of non-transparency and inconsistency between decisions.

Lastly, there are several extensions of the CAPM which aim to address the shortcomings associated with the traditional CAPM. These are presented here for completeness but there is not enough evidence that these models are widely used in the investment community. IPART also believes that these cannot easily be implemented by regulators.

The following sections describe the alternative cost of equity models in a more technical way and assess their applicability to the regulatory context. We have assessed these alternative cost of equity models against the assessment criteria set out in section 2.2 and come to the conclusion that none of these alternative models meet our assessment criteria. The non-technical reader may wish to skip to chapter 7.

### 6.2 Fama-French model

There is a significant literature identifying anomalies that cannot be explained by the CAPM. These anomalies represent factors beyond systematic risk that have been found to be related to returns. The most famous of the anomalies were put forward by Fama and French in what is termed the Fama and French three factor model.

The Fama and French model can be seen as an augmented CAPM. It retains the basic CAPM but adds 2 factors to explain variations in the return on equity.

Fama and French found that by incorporating factors to capture firm size and value, much of the cross-section of average stock returns could be captured (and much more than captured simply through using an estimate of the exposure of the equity to systematic risk). They specified a model of returns as:

$$R_c = R_f + \beta_c (R_m - R_f) + s_e \text{SMB} + h_e \text{HML}$$

Where:
- $R_f$, $\beta_c$, and $R_m$ are all defined as per the CAPM
- $\text{SMB}$ is the size premium, constructed as the difference between the return for portfolios of small and large firms
- $\text{HML}$ is the value premium, constructed as the difference between the return for portfolio of firms with high and low book-to-market values

---


\[
\begin{align*}
\n\text{SMB (Small Minus Big) reflects the size premium that investors have historically received for investing in stocks of companies that are small. Here, size refers to the total market value of a firm’s shares. Consequently, a positive SMB reflects that small capitalisation stocks outperformed high capitalisation stocks for a given period.}

\text{HML (High Minus Low) represents a value premium that is typically returned to investors for investing in firms that have a high book value relative to their market value, known as value firms. HML is historically positive, indicating that value stocks have outperformed growth stocks (low book-to-market stocks). By including these variables, Fama and French have shown both that these variables consistently have high explanatory power (typical R-squared around 0.95), as well as eliminating the marginal impact of a wide range of other anomalies.40}

\text{For regulated companies, which are often of medium size and high book to market value, the Fama French estimates could provide higher estimates of the cost of capital, as investors require higher returns on capital to invest in companies with high book to market ratios, according to the model. For UK electricity distributors, the maximum effect has been estimated at 1.25%.41}

\text{The Fama and French model has had some interest from regulators but it has not been implemented42. It is however used in financial markets, especially in portfolio management. An important point is that whereas an analyst in financial markets is trying to value a specific company, the regulator, under incentive regulation, is seeking to establish a benchmark cost of capital for a sector that can potentially be applied to more than one entity.}

\text{6.2.1 How does the Fama and French model measure up against our assessment criteria?}

\text{The Fama and French model does result in cost of equity estimates that are consistent with market expectations. However, the model introduces two additional terms, the size and the value term, which makes it more complicated to apply in practice. It is also not clear whether the approach is consistent with the CAPM assumptions as the size or value terms may include some business-specific risk.}

\text{Overall, we do not believe that the Fama and French model is a better model than the CAPM to estimate the cost of equity capital.}

\text{40 Smithers and Co. 2003, A Study into Certain Aspects of Capital for Regulated Utilities in the U.K., prepared for the UK regulators p 70.}

\text{41 Smithers and Co., 2006, Report on the cost of capital, prepared for OFGEM, p 3.}

6.3 Dividend growth model (DGM)

The DGM estimates the cost of equity through positing a relationship between the market value of an asset and the future payment flow from the asset. That is, the market value of an asset is equal to the present value of future payments from the asset. In the case of listed equity, the market value is the share price and the future payments are dividends. The equation used to link the share price \( P_0 \) and expected dividend stream \( D_t \) is as below.

\[
P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1 + k)^t}
\]

The cost of capital required by the market is \( k \). Given information on expected dividends and the current share price, the cost of equity can be determined.\(^{43}\)

Typically, a simpler version of the DGM is used, known as the Gordon Growth Model. If we expect dividends to grow at a constant rate, \( g \), in perpetuity then the equation above can be re-written as

\[
P_0 = \frac{D_1}{(k - g)}
\]

Or rearranging,

\[
k = \frac{D_1}{P_0} + g
\]

Hence, the dividend growth model calculates the value of a business by dividing expected future dividends by the cost of capital minus the growth rate. This can be rearranged to solve for the cost of capital.

While a relatively simple model, there are several issues associated with its implementation by regulators:

- The DGM can be considered as a relatively short term measure of the cost of equity currently sought by the market. As market conditions change, the estimated cost of equity can change quickly.

- It can be difficult to accurately gauge market participants' expectations of future dividends. Publicly available forecasts may differ from those engaged in market activity. The uncertainty associated with dividend growth suggests that the cost of equity should be calculated under optimistic and pessimistic scenarios.

\(^{43}\) A similar method is the comparison of market value with the regulated asset base. It could be interpreted that the regulator is setting a generous cost of capital if the market value is greater than the regulated asset base, or vice versa. However, this ratio also reflects other factors such as changes in demand and cost, relative to that allowed by the regulator.
The assumption of a constant growth rate is unrealistic and may lead to significant errors.

There are very few listed companies in Australia that have substantial regulated components.

6.3.1 **How does the dividend growth model measure up against our assessment criteria?**

In principle, the dividend growth model should result in a cost of equity estimate that is consistent with market expectations. However, this will be highly dependent on:

- the assumed dividend payout ratio, and
- the assumed level of growth.

This implies that the most important inputs into this model are determined by the regulator and not determined by the market. This model is thus less transparent than the CAPM.

On the other hand it can be implemented using industry average dividend payout ratios and growth levels. But, it is less practicable to implement as it has to be modelled on a full discounted cash flow analysis.

We believe that the dividend growth model could be used as a cross-check for our cost of equity (and WACC) estimate but it does not meet our assessment criteria for a stand alone cost of equity capital model.

6.4 **Arbitrage pricing theory**

The Arbitrage Pricing Theory (APT) provides an alternative method to CAPM for calculating the cost of equity. The APT develops a method for estimating the true value of an asset through a linear combination of independent macroeconomic (or other) factors:

\[
E(R_e) = R_f + b_1\lambda_1 + b_2\lambda_2 + \ldots + b_n\lambda_n
\]

Where, \(E(R_e)\) is the expected rate of return; \(R_f\) is the risk-free rate as per the CAPM; \(\lambda_1 \ldots \lambda_n\) are the risk premia associated with an unexpected movement in the explanatory macroeconomic (or other) factors; and \(b_1 \ldots b_n\) measure the sensitivity of the return on equity to the factors \(\lambda_1 \ldots \lambda_n\) respectively.
The basis of the model is that investors care about their exposure to the underlying factors. They will arbitrage (in expectation) across assets to manage their exposure. The process of arbitrage ensures that assets are priced as a linear combination of the underlying factors.

The single biggest weakness of APT is that it does not specify the macroeconomic or other factors that should be included and that investors are attempting to minimise their exposure to.

6.4.1 How does the arbitrage pricing model measure up against our assessment criteria?

The arbitrage pricing model probably delivers the best cost of equity estimate for individual investors as it has the ability to take into account the desired risk exposure on an individual basis. However, in the regulatory context this is a short coming as the number of possible inputs makes the model:

- not easily implementable
- not transparent in the choice of inputs.

At this stage, we do not believe that the arbitrage pricing model is a suitable alternative to the CAPM in the regulatory context.

6.5 Extensions to the CAPM

In recognising some of the empirical weaknesses of the CAPM, and the need for relaxing some of the unrealistic assumptions, numerous modifications and extensions to the standard CAPM have emerged. These extensions which have been raised in the AER review of WACC parameters and of the regulatory determinations are discussed below.

6.5.1 Risky assets

The standard or Sharpe CAPM requires that all investors must hold the same portfolio, and that this portfolio be the market portfolio. Fisher Black (1972)\(^{44}\) has generalised this model such that each investor can hold a different portfolio of risky assets. The market portfolio is the weighted sum of the individual investors’ portfolios and will be on the efficient frontier and will be an efficient portfolio. Black’s version of the CAPM does not assume that investors can all borrow at the risk-free rate, rather any risky asset can be used, as long as it has no correlation with the market portfolio (zero-beta portfolio).

\[
R_x = R_x + \beta_x (R_m - R_f)
\]

---

Where $R_z$ is the rate of return on the asset $z$, which is uncorrelated with the return on the market portfolio $R_m$.

By allowing unrestricted short sales of risky assets, the Black generalisation removes the need for the unrealistic assumption of unrestricted risk-free borrowing and lending. However, ‘the assumption that short selling is unrestricted is as unrealistic as unrestricted risk-free borrowing and lending.’\(^{45}\) This means that without unrestricted access to risk-free lending and borrowing, or short sales of risky assets, the market portfolio is not typically efficient.\(^{46}\)

### 6.5.2 Intertemporal CAPM

In the standard CAPM, investors are only concerned about the return on their investment at the end of the current period. Merton (1973) reformulated the CAPM over multiple periods, known as the intertemporal CAPM (ICAPM). In Merton’s ICAPM investors care both about their end-of-period payoff as well as the opportunities to consume or invest the payoff. Consequently, investors are concerned about how their future wealth may vary with macroeconomic variables such as labour income, the prices of consumption goods, and expectations for the former and latter in future time periods.

As with the CAPM, investors in the ICAPM are concerned with maximising their return for a given risk (or equivalently minimising risk for a given return). In addition, however, investors in the ICAPM are concerned with how the portfolio returns covary with the macroeconomic variables. Consequently, optimal portfolios must be multifactor efficient, which requires optimising expected return for a given return variance and covariance between expected return and macroeconomic variables.

The ICAPM maintains the assumption of unlimited risk-free borrowing and lending or unrestricted short sales of risky assets, as used in the standard and Black versions of the CAPM. The model does not identify the macroeconomic variables that constitute intertemporal risk or the relative importance of these intertemporal risks.

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6.5.3 Consumption CAPM

Multifactor models attempt to improve the empirical performance of the CAPM by identifying factors, in addition to market risk, to explain the return to a stock or portfolio. However, these models do not provide any information upon which to base the selection of these factors. Breeden’s extension of the CAPM provides a neat way of reducing all of these other factors into one variable, consumption. This model assumes not portfolio maximisation, but rather consumption, where the buying and selling of assets is used to smooth consumption over time.

Unlike the CAPM which measures the risk of an asset as the variance of its return, in the consumption CAPM (CCAPM) the risk premium is measured by the covariance of its return with consumption. Assets whose return is high when consumption is high (and marginal utility of consumption is low) are more risky, and therefore less desirable to hold. Conversely, assets that have a negative covariance with consumption have a lower risk premium. So the asset’s systematic risk is associated with the state of the economy (consumption).

The benefit of this approach is that it provides the most general theory of risk, and encapsulates all risk, the risk to future consumption. However, its application to real world analysis is difficult: consumption data, upon which this model relies, is difficult to source, it provides no specification of investors’ utility, and it relies upon the rationality of individual investors.

6.5.4 How do the extensions of the CAPM measure up against our assessment criteria?

We do not believe that any of the extensions of the CAPM presented above provide a better alternative to the CAPM currently used by Australian regulators. All three extensions are more difficult to replicate and it is unclear whether any of them provides any additional benefit in the regulatory context. For the intertemporal and the consumption CAPMs there is also the additional difficulty in defining the input data and obtaining transparent input data.

At this stage, we do not believe that any of the extensions of the CAPM meet our assessment criteria better than the CAPM.

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7 Possible future directions for IPART

The overwhelming use of the standard CAPM by regulators and market practitioners, both in Australia and overseas, suggests that there is little reason for IPART to change from this approach. The CAPM is well understood by regulated companies and regulators and there is a substantial Australian and international body of evidence regarding the estimation of its parameters.

However, there may be scope for IPART to use other methods as a cross-check to estimates of the cost of equity from the standard CAPM.

This chapter sets out feasible approaches, the ability of these approaches to complement the use of the CAPM and to improve the estimates of the cost of capital. It is noted, that different regulatory reviews will require different approaches, particularly in considerations such as the use of project-specific estimates of the cost of capital.

7.1 Possible approaches

Chapters 4 and 5 have set out in detail alternative approaches to estimating the cost of capital and the approaches that are used by Australian and overseas regulators and market practitioners. From this it is clear that there are few approaches that have attracted support for theoretical, empirical and practical reasons.

The approaches that we consider are feasible are:

- Using the dividend growth model and surveys of market practitioners to cross-check estimates of the MRP.
- Using the DGM as a cross-check on the CAPM estimate of the cost of equity using comparator companies listed on the stock exchange.
- Using the DGM as a cross-check of the regulatory cost of equity.
- Considering alternative implementations of the CAPM, such as using a set of assets with greater weight on international assets, although recognising that this would require that other parameters of the WACC are consistent with this approach.

The strengths and weakness of these approaches are set out below.

7.2 The DGM and surveys as a cross-check on the MRP

The MRP is currently set by IPART on the basis of the long term average historical excess returns on listed equity. The DGM and surveys provide a cross-check that could provide forward-looking information on the MRP. However, we note that there are substantial difficulties involved in attempting to measure, with any precision, a forward looking MRP using an approach such as the Dividend Growth
Model because of the uncertainty about estimates of future dividends and their growth rate. For more information on our MRP estimate, please consult the discussion paper on IPART’s cost of capital after the AER’s WACC review48.

7.3 The DGM applied to comparator companies

An alternative to applying the DGM to the market as a whole would be to pick particular listed companies that could be viewed as comparators to the regulated company. The cost of equity for these companies could then be calculated based on their expected dividend growth and current share price.

The most important concern with this approach is identifying appropriate listed comparators. This is more difficult in Australia than in countries like the UK, because there are few regulated listed companies, and the regulated part of their business is often small.

Note that where a regulated company is listed, it is possible to apply the DGM directly to that company. IPART does not currently regulate any companies that are publicly listed.

7.4 How could the DGM model be used in the regulatory context?

This section estimates the cost of equity using two methods — the DGM and the standard CAPM. These methods are applied to two listed Australian companies that are comprised of largely regulated assets and could be considered comparators for other regulated businesses. We already noted that we do not believe that the DGM should be used to estimate individual inputs into the cost of equity such as the MRP because of the significant uncertainty involved in forecasting future dividends and their growth rate.

7.4.1 Choice of companies

There are a number of Australian listed companies that own and operate regulated assets. However, most of these companies also have significant other non-regulated businesses. This case study considers two companies that are comprised almost entirely of regulated assets, most of which are located in Australia:

▼ DUET Group is an owner of energy utility assets in Australia and the United States. Most of its assets are located in Australia. It owns shares of WA gas pipeline assets, electricity distribution assets in Victoria, gas distribution assets in WA and Victoria and electricity transmission and distribution in Pennsylvania, USA. Approximately 80% of its assets are in Australia.

48 Available on our website: www.ipart.nsw.gov.au
SP AusNet is an owner of energy utility assets in Australia. Its assets are electricity and gas distribution assets in South East Australia.

The composition of assets for these 2 companies is set out in Figures 7.1 and 7.2.

**Figure 7.1 Composition of DUET**

![Composition of DUET](image)

DUET is a stapled security comprising share and unit trust.  
*Source: Bloomberg, accessed 12 October 2009.*

**Figure 7.2 Composition of SP AusNet**

![Composition of SP AusNet](image)

SP AusNet is a stapled security comprising share and unit trust.  
*Source: Bloomberg, accessed 12 October 2009.*

IPART does not regulate electricity and gas network assets. However, utility assets are considered good proxies for other regulated assets.
Other relevant information for DUET and SP AusNet is set out in Table 7.1. Both SP AusNet and DUET are more highly geared than typically assumed in our estimates of the cost of equity for regulated companies.

### Table 7.1 Company information

<table>
<thead>
<tr>
<th>Category</th>
<th>DUET</th>
<th>SP AusNet*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total revenue 2008/09 ($bn)</td>
<td>1.04</td>
<td>1.17</td>
</tr>
<tr>
<td>Total book value of assets year end 2009 ($bn)</td>
<td>7.95</td>
<td>7.82</td>
</tr>
<tr>
<td>Market capitalisation (12 October 2009, $bn)</td>
<td>1.38</td>
<td>2.40</td>
</tr>
<tr>
<td>Gearing (%)</td>
<td>82</td>
<td>70</td>
</tr>
<tr>
<td>Share price (12 October 2009, $)</td>
<td>1.61</td>
<td>0.90</td>
</tr>
</tbody>
</table>

* SP AusNet 2008/09 information for year to 31 March 2009.

b Equity and debt share of assets calculated using market value of equity rather than book value of equity in calculating total assets.


### 7.4.2 Assumptions for the dividend growth model (DGM)

To estimate the cost of equity using the DGM we require:

- the current share price
- expected future dividends
- the period over which the company will continue to provide dividends.

#### Future dividends and long term growth

We use consensus forecasts of future dividends from Bloomberg for 2009 to 2012. For long term growth we use either the Bloomberg reported figure or the annual growth rate implied from consensus forecasts for the next 3 years.

For SP AusNet, Bloomberg consensus forecasts of six-monthly dividends rise from 3.6 cents to 4.3 cents from November 2009 to November 2012. This is equivalent to annual growth of 6.1%. The long term growth rate for SP AusNet reported by Bloomberg is 3.5%.

For DUET, Bloomberg consensus forecasts of six-monthly dividends rise from 10 cents per share to 10.9 cents per share from December 2009 to December 2012. This is equivalent to annual growth of 2.9%. The long term growth rate for DUET is 6.5%.
Period of company operation

The longer the period over which the companies are assumed to continue operating and providing dividends the greater the implied discount rate (or cost of equity) to generate today’s share price. We present results for both a 20-year period and a 40-year period.

7.4.3 Assumptions for the CAPM

To estimate the cost of equity using the CAPM we require:

- an estimate of the risk-free rate
- an estimate of the equity beta (or riskiness) of the companies
- an estimate of the market risk premium.

For the risk-free rate and market risk premium we use IPART’s standard assumptions and methods. That is, the risk-free rate is a 20-day average of the yield on 10-year Commonwealth Government bonds and the market risk premium is 5.5% to 6.5%.

For the equity beta, we consider three alternative assumptions:

- The equity beta reported for the companies by Bloomberg, calculated using the relationship between the company share prices and the Australian share market.
- The AER’s final decision on the equity beta for electricity distribution and transmission businesses (0.8), adjusted for the gearing level of the companies — this is also equal to the bottom end of the range typically chosen by IPART. The equity beta of the companies will be significantly higher than 0.8 as they are more highly geared.
- The top end of the range chosen by IPART for the equity beta (1.0), adjusted for the actual gearing level of the companies.

These assumptions are summarised in Table 7.2.

<table>
<thead>
<tr>
<th>Table 7.2 Equity beta assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assumption</strong></td>
</tr>
<tr>
<td>Bloomberg actual equity beta</td>
</tr>
<tr>
<td>AER equity beta/IPART minimum equity beta adjusted to gearing level of companies (Equity beta of 0.8)</td>
</tr>
<tr>
<td>IPART maximum equity beta adjusted to gearing level of companies (Equity beta of 1.0)</td>
</tr>
</tbody>
</table>

*Adjustments made using the Monkhause formula with a zero debt beta, gamma of 0.4, tax rate of 30% and nominal return on debt of 7%.

The estimated equity betas for the companies based on AER and IPART standard assumptions adjusted for the higher actual gearing level of Duet and SPI AusNet are considerably higher than using estimates from market information. Equity beta estimates from market data for SP AusNet and DUET are below the average of other potential comparators.50

DUET has particularly high gearing. The adjustment to the equity beta to reflect its gearing may overstate the adjustment to the cost of equity required by the market for higher gearing due to the use of zero debt beta.

### 7.4.4 Cost of equity results

The cost of equity estimates arising from the CAPM and DGM models vary considerably when basing estimates only on market data (Table 7.3). Using the market estimate of the equity beta, the nominal post-tax cost of equity for DUET and SP AusNet is between 7.8% and 9.5% using the CAPM. In comparison, the DGM suggests that the cost of equity for these companies is in the order of 10.0% to 19.3%.

A large part of the difference between the methods reflects the low systematic risk evidenced in market estimates of the equity beta. The equity beta from the market is well below the estimates used by regulators, adjusted for the gearing of the companies. If the AER’s recent final decision for the equity beta of electricity distribution and transmission is used, and adjusted for the gearing of the companies, the cost of equity estimates suggested by the two models are not that different.

If the upper estimate of IPART’s typical equity beta range is viewed as an appropriate equity beta for the two companies, adjusted for gearing, then the estimated cost of equity for the two companies using the CAPM can exceed that estimated using the DGM.

---

Table 7.3  Cost of equity (nominal, post-tax)

<table>
<thead>
<tr>
<th>Method and assumptions</th>
<th>DUET</th>
<th>SP AusNet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td><strong>CAPM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>— actual equity beta from Bloomberg</td>
<td>8.8%</td>
<td>9.5%</td>
</tr>
<tr>
<td>— equity beta from AER/IPART minimum adjusted for actual gearing</td>
<td>15.1%</td>
<td>16.9%</td>
</tr>
<tr>
<td>— equity beta from IPART maximum adjusted for actual gearing</td>
<td>17.5%</td>
<td>19.8%</td>
</tr>
<tr>
<td><strong>DGM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>— 40 years</td>
<td>16.4%</td>
<td>19.3%</td>
</tr>
<tr>
<td>— 20 years</td>
<td>15.0%</td>
<td>15.4%</td>
</tr>
</tbody>
</table>

Source: IPART’s calculations.

7.4.5  Discussion and limitations

The previous chapter suggested that the DGM could be used as a cross-check to estimates of the cost of equity from the CAPM. In this section we compare estimates on a pre-tax real basis as typically used in our regulatory frameworks and discuss the limitations of the practical implementation of the DGM approach.

On the basis of current estimates, the DGM applied to SP AusNet and DUET is not suggesting estimates of the cost of equity different than those arrived at using the standard CAPM or different from IPART’s recent decisions.

Use in IPART’s regulatory framework

The cost of equity estimates presented above are for companies that differ in a number of ways from the businesses that IPART regulates. Two areas of difference are most notable. Firstly, the companies engage in different activities than the businesses that IPART regulates. To be good comparators would require that investors require similar rates of return from businesses regulated by IPART as for regulated gas and electricity distribution and transmission.

Secondly, the companies have different levels of gearing than those typically considered as the benchmark for companies regulated by IPART. To be useful in our reviews, we would have to adjust these estimates of the cost of equity to be representative of a company with a debt to asset ratio of 60%. There are methods of adjustment, such as used for the CAPM equity beta estimates above. These methods can be applied to the cost of equity estimates from the DGM as long as the standard
CAPM equation is taken to hold and the risk-free rate to be that used by IPART. Estimates of the cost of equity can be converted to real pre-tax using estimates of gamma, the effective tax rate and expected inflation.

Results of these conversions are presented below in Table 7.4. The estimated cost of equity from the models are also compared to average real pre-tax cost of equity from recent decisions.

The cost of equity using the DGM for the two comparator companies is estimated at between 7.6% and 12.7%. The capital asset pricing model, under standard IPART assumptions suggests a cost of equity of between 8.5% and 11.9%. These estimates also align well with recent IPART decisions, for which the lower bound estimate of the pre-tax real cost of equity is 8.5% and upper bound is 12%.

The estimates of the cost of equity using the equity beta estimates from the market are well below those using AER/IPART standard assumptions and the DGM, at 5.3% to 6.7%. This reflects the much lower systematic risk of the comparator companies according to market estimated betas compared to the equity betas used in regulator’s actual decisions.

<table>
<thead>
<tr>
<th>Method and assumptions</th>
<th>DUET</th>
<th>SP AusNet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAPM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>— equity beta from Bloomberg</td>
<td>5.3%</td>
<td>6.2%</td>
</tr>
<tr>
<td>— equity beta from AER/IPART minimum adjusted for gearing</td>
<td>8.5%</td>
<td>10.3%</td>
</tr>
<tr>
<td>— equity beta from IPART maximum adjusted for gearing</td>
<td>9.7%</td>
<td>11.9%</td>
</tr>
<tr>
<td><strong>DGM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>— 40 years</td>
<td>9.2%</td>
<td>11.7%</td>
</tr>
<tr>
<td>— 20 years</td>
<td>8.4%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Average of recent IPART decisions</td>
<td>8.5%</td>
<td>12%</td>
</tr>
</tbody>
</table>

*Adjustments made using the Monkhouse formula with a zero debt beta, gamma of 0.4, tax rate of 30%, nominal risk-free rate of 5.3%, nominal return on debt of 7%, inflation rate of 2.5% and gearing of 60%.


The above analysis indicates that there is only a small difference between the cost of equity capital estimates for DUET and SPI AusNet between the CAPM and the DGM. We note that this may not always be the case. In cases where there is a material difference between the cost of equity capital estimates between different models, one has to investigate if this difference can be explained by any of the individual input

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51 This adjustment would not require information on beta or the MRP separately but on the product of the two.
parameters, such as the equity beta or the market risk premium. In a second step, one would have to determine whether this is a temporary or a permanent difference. Given the limited data available on Australian publicly traded utilities, the CAPM should be given more weight than the DGM. However, the DGM may be a good indicator for short term differences or changes in the financial market’s pricing of risk.

Potential issues and concerns

There are a number of potential concerns with the analysis presented above. The franking of dividends complicates the analysis.

- The return on equity that investors require at different levels of gearing may not be equal to that estimated using leveraging and deleveraging equations. This process is particularly sensitive to assumptions at high gearing levels, such as for DUET. At high levels of gearing it is unlikely that the debt beta is 0 or that the debt beta does not vary with changes in the level of gearing.

- Taxation has been modelled by assuming that dividends are post-tax and therefore equivalent to a post tax cost of equity from the CAPM. The pre-tax cost of capital for both DGM and CAPM is then calculated through IPART’s standard assumptions about the value of franking credits. An alternative approach was put forward by CEG, with Bloomberg dividends adjusted upwards to capture tax value of franking credits.52

7.5 Using the DGM to cross-check the regulatory cost of equity

Section 7.4 showed how the DGM can be used to estimate an implied cost of capital given projections of future dividend growth. Problems in finding comparable companies (for example in terms of similar risk and dividend growth) suggest that it would be undesirable to rely on this model to estimate the cost of equity. However, once a cost of equity has been derived (from the CAPM), the DGM can be used as a cross-check by examining the relationship between the present value of projected dividends plus the terminal value at the end of the regulatory period and the regulatory asset base at the start of the regulatory period. In a simplified way, this can be done as follows:

1. estimate the likely dividends over the regulatory horizon based on projected expected earnings and some assumption about payout ratios

2. note that the “terminal value” at the end of the regulatory horizon should be equal to the regulatory asset base less outstanding debt plus accrued net cash position

3. compare the present value of projected dividends plus terminal value, both discounted at the estimated cost of equity with the initial regulatory asset base net of debt outstanding (plus net cash position).

The 2 figures should be approximately equal. Table 7.5 shows an example of how the DGM could be used to cross-check the regulatory cost of equity. The assumptions used in this model are summarised in Table 7.6. This example is based on our 2004 electricity distribution network final decision.

Table 7.5  Using the DGM to cross-check the cost of equity

<table>
<thead>
<tr>
<th>$000 nominal</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Equity value (start RAB/equity holders only)</td>
<td>1,775,933</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(B) Terminal value (RAB end/equity holders only)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2,283,858</td>
</tr>
<tr>
<td>Profit after tax</td>
<td>97,092</td>
<td>95,831</td>
<td>101,654</td>
<td>113,760</td>
<td>128,285</td>
</tr>
<tr>
<td>Cash flow (dividends paid and terminal value net of equity raising)</td>
<td>77,673.50</td>
<td>76,664.47</td>
<td>81,323.14</td>
<td>91,007.81</td>
<td>1,985,884*</td>
</tr>
<tr>
<td>(C) NPV of cash flows plus terminal value net of equity raisings</td>
<td>1,395,519</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Difference (A) and (C)</td>
<td>380</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other calculations</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Retained earnings (added to equity)</td>
<td>19,418</td>
<td>19,166</td>
<td>20,331</td>
<td>22,752</td>
<td>25,657</td>
</tr>
<tr>
<td>initial equity (RAB+ additions)</td>
<td>1,795,351</td>
<td>1,814,517</td>
<td>1,834,848</td>
<td>1,857,600</td>
<td>1,883,257</td>
</tr>
<tr>
<td>(D) equity capital raising*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* In the final year, we have assumed that "initial equity" + "retained earnings" + "external equity raising" equal to the terminal equity. This means that any shortfall in cash is raised through new equity. This new equity is deducted from the terminal value as it does belong to the new equity holders, not those at the beginning of the regulatory period.

b  (B-D)

Table 7.6  Model assumptions

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>60%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return on equity (nominal)</td>
<td>11.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dividend payout ratio</td>
<td>80%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the example in Table 7.5, the difference between the DGM implied NPV and the regulatory asset base (RAB) at the beginning of the regulatory period is $380,000. This is close enough and one would expect that the return on equity used in this model is appropriate.
This is a relatively straightforward use of the DGM. However, it relies on the regulatory financial model and not financial market data.

### 7.6 Using a broader set of assets in estimating the CAPM

The CAPM is theoretically built on the market being defined as all assets, including physical, human and social capital embodied in listed equity, real estate, unlisted companies, bonds etc. In practice, only domestic listed equities are used to estimate CAPM parameters.

It would be feasible to expand the set of assets captured by the CAPM to include bonds and/or international assets. The logic of this is that these assets represent alternative options for investors. This should provide a more precise estimate of the cost of equity if using only listed equity biases estimates for some companies up and some down.

**Inclusion of bonds**

The market could be broadened to include Australian corporate bonds through the market being defined as a weighted average of listed equities and a corporate bond index. The shares of equity and corporate bonds would reflect the size of these asset classes.

Davis (2005)\(^{53}\) examines both the beta of government debt and implications of including government debt in the market portfolio. Because of the decline in government debt on issue since the mid 1990s, its inclusion in the market portfolio is unlikely to have much effect. There is also very little true domestic corporate debt on issue, although kangaroo bonds\(^{54}\) and residential mortgage-backed security issues (RMBS)\(^{55}\) had grown significantly until the global financial crisis.

The other parameters of the CAPM may have to be re-estimated to reflect the changed market definition (such as the MRP, tax imputation, tax rates).

**Inclusion of international assets**

The market could be broadened to include international assets through the market being defined as a weighted average of Australian assets and exchange rate adjusted foreign assets (such as the world share index).

---


\(^{54}\) A foreign bond that is issued in the Australian market by non-Australian business and is denominated in Australian currency.

\(^{55}\) A type of security whose cash flows come from residential debt such as mortgages, home-equity loans and subprime mortgages. This is a type of mortgage-backed securities that focuses on residential instead of commercial debt.
Again, the other parameters of the CAPM would have to be re-estimated to reflect the changed market definition.

Summary

Broadening the definition of assets outside of listed Australian assets is more consistent with the theoretical basis for the CAPM. However, there is a substantial body of evidence that has been built up about the CAPM parameters when the model is implemented using only listed domestic equities. Moving away from this by adopting a new approach would be a significant disadvantage.

7.7 Other models

There are other models that can be used to estimate the cost of equity of a publicly traded business.

For example, market practitioners may use the accounting/earnings–based “residual income” approach to valuation, which can be shown to be equivalent to a cash-flow (dividend based) approach, but uses earnings data instead. There have been several papers\(^{56}\) which have attempted to “back-out” the cost of equity capital using this model, but (given the difficulties in that approach, including reliance on analyst forecasts of future earnings) it is, perhaps, more appropriately used as a cross-check approach. That would be done by using the CAPM derived cost of equity in the model to determine whether projected expected earnings have a present value equal to the regulatory asset base.

7.8 Impact of giving weight to different approaches

In deciding on a future approach or approaches, IPART will consider:

▼ Whether alternative approaches better align the cost of equity set by the regulator with the cost of equity required by the market over the regulatory period.

▼ The impact of alternative approaches on regulatory certainty.

▼ The ability of the approaches to sit within the broader regulatory frameworks that apply for each particular regulated business.

Giving weight to alternative approaches that provide forward-looking information may better align the cost of equity set by the regulator with that required by the market, particularly in times of significant economic change\(^{57}\).


\(^{57}\) For example, Ofwat in the UK commissioned Europe Economics to recommend a WACC for its 2009 water industry review. In its recommendation, Europe Economics used the DGM to cross-check the CAPM cost of equity estimate.
However, we would argue that a small weight should currently be placed on these methods until they are further advanced in an Australian regulatory context, to reduce regulatory uncertainty arising from the use of these methods. The regulatory body of evidence behind the CAPM is substantial and a significant barrier to alternative approaches. The CAPM is well understood by regulators and regulated businesses, even though it has limitations. Giving too much weight to alternative approaches would likely lead to greater regulatory uncertainty, as these methods do not have the level of precedent of the CAPM.

We also note that there is limited financial markets evidence on Australian utilities. While the alternative CAPM models presented in this paper are implementable in the US where there are ample publicly traded utilities, this is not the case in Australia. This means that most of the alternative CAPM models presented in this paper may not be implementable in Australia at the company or even the industry level.

IPART seeks comments on the following

2 Should IPART consider any alternative approaches for estimating the weighted average cost of capital and cost of equity? Should these approaches be used only as a cross-check on the CAPM? How much weight should be given to these approaches?

3 Do the alternative approaches better align the cost of equity set by the regulator with the cost of equity required by the market?

4 Will the different approaches impact on the incentives facing regulated businesses?
Appendices
Alternative approaches to the determination of the cost of equity
\section*{A \hspace{1em} WACC formula}

There are a number of input parameters to consider in determining an appropriate WACC range. Some of these parameters are directly determined by the market, while others are determined by IPART according to a preferred theoretical approach.

The calculation of the cost of capital under the WACC framework requires the estimation of the following parameters:

1. Parameters determined by financial market data:
   \begin{itemize}
   \item risk free rate ($R_f$)
   \item debt margin ($R_D - R_f$)
   \item adjustment for expected inflation ($\Pi$).
   \end{itemize}

2. Parameters determined through other methods:
   \begin{itemize}
   \item the market risk premium (MRP) ($R_m - R_f$)\textsuperscript{58}
   \item the degree of systematic risk ($\beta_e$ - equity beta)
   \item the level of gearing ($D$-debt, $E$-equity)
   \item the value of imputation credits ($\gamma$ - gamma).
   \item the return on equity ($R_e$).
   \end{itemize}

The parameters of the WACC are related to each other. For instance, a higher level of gearing implies a higher debt margin and a higher equity beta than would otherwise be the case.

These parameters are combined through the formula below, to give the pre-tax real WACC.

\[
WACC = \left(1 + \frac{R_e}{(1 - t)(1 - \gamma)} \left(1 + R_f \cdot \frac{E}{D + E} \right) \right) - 1
\]

\textsuperscript{58} The market risk premium is the excess return of the share market over the risk free rate.
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bayesian</strong></td>
<td>Refers to methods in probability and statistics named after the Reverend Thomas Bayes.</td>
</tr>
<tr>
<td><strong>Capital asset pricing model (CAPM)</strong></td>
<td>The CAPM is used in the estimation of the cost of equity. The CAPM is based on the assumption that an investor in an asset requires additional returns to compensate for the risk borne. Thus, the CAPM states that a firm’s cost of equity capital is equal to the risk-free rate of return on the market, plus a premium above the risk-free rate, to reflect the relative riskiness of the investment.</td>
</tr>
<tr>
<td><strong>Cost of capital</strong></td>
<td>Is the weighted average cost of equity and debt capital.</td>
</tr>
<tr>
<td><strong>Cost of equity</strong></td>
<td>The cost of equity is one of the inputs into the weighted average cost of capital.</td>
</tr>
<tr>
<td><strong>Dividend payout ratio</strong></td>
<td>The percentage of profit that is paid out in dividends.</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>Statistical term for average.</td>
</tr>
<tr>
<td><strong>Multifactor models</strong></td>
<td>When more than one input into a model determines the outcome. For example in the CAPM it is only the equity beta that determines the required return of an investment. In multifactor models, more inputs are added to fine-tune the required return.</td>
</tr>
<tr>
<td><strong>Ordinary least squares</strong></td>
<td>Is a technique for estimating the unknown parameters in a linear regression model. This method minimizes the sum of squared distances between the observed responses in a set of data, and the fitted responses from the regression model.</td>
</tr>
<tr>
<td><strong>Portfolio</strong></td>
<td>A portfolio is a combination of different investments. The return on the investment portfolio is the weighed average of the returns of all the investments in the portfolio.</td>
</tr>
<tr>
<td><strong>Short selling</strong></td>
<td>Short selling refers to selling assets that one does not own with the aim of re-buying them at a later stage when asset values have declined.</td>
</tr>
<tr>
<td><strong>Single period</strong></td>
<td>Statistical term to define that the data is estimated over a defined period of time.</td>
</tr>
<tr>
<td><strong>Standard deviation</strong></td>
<td>A statistical measure of how close an estimate is to the average. A low standard deviation indicates that the data points tend to be very close to the mean, whereas high standard deviation indicates that the data are spread out over a large range of values.</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Systematic risk</strong></td>
<td>Non-business specific risk – or the amount of risk a company contributes to total market risk.</td>
</tr>
<tr>
<td><strong>Unsystematic risk</strong></td>
<td>Business specific risk – not accounted for in the CAPM.</td>
</tr>
<tr>
<td><strong>Utility</strong></td>
<td>Utility is a measure of the relative satisfaction from, or desirability of, consumption of various goods and services. In finance, we often use the concept of utility to say that for a given level of risk rational investors prefer a higher return to a lower return.</td>
</tr>
</tbody>
</table>