Explanatory Statement for the Draft Rate of Return Guidelines

Meeting the requirements of the National Gas Rules

6 August 2013

Economic Regulation Authority

WESTERN AUSTRALIA

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Economic Regulation Authority
Perth, Western Australia
Phone: (08) 6557 7900

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1 Introduction

1. The Authority's responsibilities under the National Gas Law (**NGL**) and the National Gas Rules (**NGR**) relate to approving third party access regimes in Western Australia for the Dampier to Bunbury Natural Gas Pipeline, the Goldfields Gas Pipeline and the Mid-West and South-West Gas Distribution System.

2. Under the recent changes to the NGR, the Authority is required to produce rate of return guidelines at least every three years.[1] The guidelines provide an opportunity to undertake a comprehensive review of approaches for determining the rate of return on capital.

3. The companion to this document – the Draft Rate of Return Guidelines – sets out the Authority's proposed approach to meeting these requirements. This Draft Explanatory Statement sets out the Authority's reasoning for the positions contained in the Draft Rate of Return Guidelines. This Statement also sets out the Authority's proposed process and timeline for consulting with stakeholders on the Draft Explanatory Statement and Draft Rate of Return Guidelines.

4. Submissions on any matter related to the Draft Explanatory Statement and Draft Rate of Return Guidelines are invited from stakeholders. These may be in either written form or, preferably, electronic form. Submissions should be marked to the attention of Dr Duc Vo and addressed to:

   Rate of Return Guidelines Review
   Economic Regulation Authority
   PO Box 8469
   Perth BC, WA 6849

   Email: publicsubmissions@erawa.com.au

   Submissions must be received by **4:00 pm (WST)** on **Thursday 19 September 2013**.

5. The Authority prefers that all submissions be in an electronic format and be made publicly available, so as to facilitate an informed, transparent and robust consultation process. Accordingly, submissions will be treated as public documents and posted on the Authority's website, www.erawa.com.au, unless prior arrangements are made with the Authority to treat the submission, or portions of it, as confidential.

6. For further information, please contact Dr Duc Vo on (08) 6557 7900 or email at duc.vo@erawa.com.au or Richard Begley on (08) 6557 7900 or email at richard.begley@erawa.com.au.

7. The Authority also acknowledges the advice received from other members of the ERA Secretariat, in particular Stefan Mero and Beauden Gellard.

[1] NGR 87(13)

1.1 The requirement

8. The new NGR require that the rate of return guidelines set out the:[1]

- methodologies that the Authority proposes to use in estimating the allowed rate of return, including how those methodologies result in a determination that is consistent with the allowed rate of return objective; and
- estimation methods, financial models, market data and other evidence that the Authority proposes to take into account in estimating the return on equity, the return on debt and the value of imputation credits.

9. The Authority considers that 'methodologies' refer to the systems of methods used in development the rate of return guidelines, and encompass the subsidiary estimation methods, financial models, market data and other evidence.[2] 'Estimation methods' provide for the procedures used for estimating the rate of return. 'Financial models' refer to those mathematical and statistical representations that are used to inform the rate of return, such as, for example, the Sharpe-Lintner Capital Asset Pricing Model. 'Market data' refers to any input data that is utilised for the rate of return, and may include, for example, financial data, or sample data from comparable firms to the benchmark. 'Other evidence' may be broad ranging and is considered without limitation, except that it needs to be 'relevant' to the estimation of the rate of return.

10. The rate of return guidelines will provide guidance for subsequent gas access decisions of the Authority for the three Western Australian gas pipelines and networks, although they will not be mandatory.[3] The Authority or service providers may depart from the guidelines in reviewing an access arrangement, provided that adequate explanation is provided at the time of the review.

11. The first rate of return guidelines must be finalised and published by the Authority by 29 November 2013.

1.2 Developing the rate of return guidelines

12. The development of the rate of return guidelines has allowed the Authority to review its approach to setting the rate of return for decisions relating to its future decisions on covered gas pipeline and network access arrangements.

13. As part of its consultation process, the Authority published an Issues Paper in December 2012, and received nine submissions from stakeholders. The Secretariat has also:

- attended the public workshops held by the Australian Economic Regulator; and
- released a Working Paper on the Cost of Debt, held a workshop on 3 July 2013, and received four submissions from stakeholders on this topic.

14. The Authority will continue to engage stakeholders to obtain input to its development of the rate of return guidelines.

[1] NGR (14)

[2] The Oxford Dictionary definition refers to a 'system of methods' (see oxforddictionaries.com).

[3] NGR (18)

15. The Authority in its review has maintained a focus on the overall methodologies, estimation methods, financial models, market data and other evidence for developing the rate of return. This focus is consistent with the requirements of the NGR.

16. However, where appropriate, the Authority has set out current indicative rate of return parameter. However, the specific parameter values arising from the application of the rate of return methodologies would be developed at each subsequent access arrangement review.[4]

1.2.1 Consultation on the rate of return guidelines

17. The Authority will consult stakeholders as part of the finalisation of the proposed rate of return guidelines. The Authority will also continue to conduct workshops and engage through other consultations as required. The need for such additional consultation will be determined on an as needed basis.

18. Consistent with the requirements of the amended rules, the Authority sets out its revised timeline for consultation on the rate of return guidelines as follows in Table 1.

Table 1 Revised timeline for development of and consultation on rate of return guidelines

Milestone	Date
Publication of the Consultation Paper	21 December 2012
Submissions on Consultation paper	End February 2013
Stakeholder workshops as required	April/May/June 2013
Draft rate of return guidelines	July/August 2013
Submissions on draft Rate of Return Guidelines	**19 September 2013**
Stakeholder workshops as required	September/October/November 2013
Final Rate of Return Guidelines	**No later than 29 November 2013**

[4] The 'review submission dates' for the three gas networks regulated by the Authority are 18 months apart (the 'review submission date' means a date on or before which an access arrangement revision proposal is required to be submitted – see Australian Energy Market Commission 2012, *National Gas Rules*, www.aemc.gov.au, Version 14, 49 to 52). The length of these periods, combined with the limited number of gas networks access arrangement reviews, has meant that the Authority has, in the past, been able to consider each review on a case by case basis. The Authority expects that this case by case approach will continue for the development of the parameter estimates.

2 The broad regulatory framework

19. This chapter sets out the Authority's views on the regulatory framework that informs the development of the rate of return guidelines. It first sets out the origins of, and the current broad approach to, regulation of energy utilities in Australia. It then summarises the requirements of the National Gas Law and the National Gas Rules, and draws on these to articulate a framework for the rate of return regulatory decision making process.

20. The chapter then draws on this framework to develop the set of criteria that the Authority will use to inform its regulatory judgment in future access arrangement decisions.

2.1 Incentive regulation

21. Incentive regulation has a reasonably short history in Australia. Up until 1990 public ownership of monopoly infrastructure was one recognised way to control monopoly behaviour, as it provided a 'window' for the government, as the major shareholder, to control output, as well as influence levels of investment and operating costs.

22. However, it also was recognised that this approach to dealing with monopolies often entailed significant economic loss, as it did not provide the expected discipline on inefficient investment and operating expenditures. Utilities often continued to 'game' the government owner, extracting monopoly rents through unproductive activities such as 'x inefficiency' and 'gold plating'.[5,6]

23. By the 1980s, these problems were being recognised, and in response, new regulatory approaches were being developed:[7]

> Beginning in the 1980s, theoretical research on incentive regulation rapidly evolved to confront directly imperfect and asymmetric information problems and related contracting constraints, regulatory credibility issues, dynamic considerations, regulatory capture, and other issues that regulators have been trying to respond to for decades but in the absence of a comprehensive theoretical framework to guide them.

24. This led to a rapid change in approach from the late 1980s to adopt 'incentive regulation:[8]

> What do we mean by incentive regulation? In particular, it means that the regulator delegates certain pricing decisions to the firm and that the firm can reap profit increases from cost reductions. Incentive regulation makes use of the firm's information

[5] This situation contrasted with that in the United States, where private ownership and statutory monopoly regulation through independent 'cost of service' (or rate of return) regulation had existed for much of the 20th Century. However, it was recognised from the 1960s on that this approach could also lead to inefficiencies, particularly through a tendency to increase capital investment (the 'Averch Johnson' effect). Some economists suggested that the outcomes were no better than unregulated monopoly.

[6] This situation contrasted with that in the United States, where private ownership and statutory monopoly regulation through independent 'cost of service' (or rate of return) regulation had existed for much of the 20th Century. However, it was recognised during the 1960s that this approach could also lead to inefficiencies, particularly through a tendency to increase capital investment (the 'Averch Johnson' effect). Some economists suggested that the outcomes were no better than unregulated monopoly.

[7] Joskow P. 2006, *Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks*, Cambridge Working Papers in Economics 0607, http://ideas.repec.org/s/cam/camdae.html.

[8] Vogelsang I. 2002, Incentive Regulation and Competition in Public Utility Markets: A 20-Year Perspective, *Journal of Regulatory Economics*; 22:1, p. 6.

advantage and profit motive. The regulator thus controls less behaviour but rather rewards outcomes.

Worldwide, the introduction of incentive regulation has been part of the regulatory reform movement, consisting of privatization, liberalization and deregulation...

...The most important types of incentive regulation have been price caps, rate case moratoria, profit sharing, banded rate of return regulation, yardstick regulation, and menus. Overall, price caps have become the most widespread...

...Price caps are defined by an index of the regulated services that is adjusted annually by (1) an inflation factor that takes care of the economy-wide price level or of the level of input prices, (2) an X-factor that reflects efficiency improvements of the firm, and (3) a Y-factor that allows for pass-through of specific cost items outside the firm's control. The index is further adjusted in regulatory proceedings over the longer-term

2.1.1 Incentive regulation in Australia

25. The policy response in Australia was to initiate and adopt the recommendations of the 1993 Hilmer review, which set out a comprehensive program of microeconomic reform for the monopoly utility sector.[9] Hilmer's proposed reforms for competition policy included the restructuring of public sector monopoly businesses, and the arrangements to facilitate third party access to nationally significant infrastructure. The intent was to introduce the discipline of competitive markets wherever possible, and to regulate for efficiency in the remaining monopoly elements.

26. These proposals were subsequently broadly implemented by the Council of Australian Governments, through the Competition Principles Agreement of 1995 and associated reforms. In addition, under clause 2 of the Competition Principles Agreement, states and territories undertook to establish independent sources of prices oversight for their monopolistic business enterprises.

2.1.2 Incentive regulation for gas infrastructure

27. These arrangements, once established, continued to evolve. In the case of gas, the updated 2009 National Gas Law (**NGL**) provides for a legislated uniform national framework governing access to monopoly gas infrastructure, and arrangements for prices oversight. The national gas objective (**NGO**) sets out the aim of the NGL:[10]

The objective of this Law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.

28. The Authority notes that it is clear that NGL and the NGO is intended to promote economic efficiency:[11]

The national gas objective is an economic concept and should be interpreted as such.

The long term interest of consumers of gas requires the economic welfare of consumers, over the long term, to be maximised. If gas markets and access to pipeline services are efficient in an economic sense, the long term economic interests of consumers in respect of price, quality, reliability, safety and security of natural gas

9 For a summary, see http://ncp.ncc.gov.au/pages/reform.

10 Western Australian Government Gazette 2009, *National Gas Access (WA) Act 2009*, www.slp.wa.gov.au, p. 76.

11 National Gas (South Australia) Bill 2008, *Second Reading Speech*, www.ret.gov.au, p. 4.

services will be maximised. By the promotion of an economic efficiency objective in access to pipeline services, competition will be promoted in upstream and downstream markets.

29. A number of revenue and pricing principles (**RPP**) in the NGL give effect to the objective.[12] The RPP establish that the NGO is to be promoted by targeting economically efficient outcomes, through effective *incentives* for efficient investment in infrastructure and efficient provision of services and the use of the infrastructure, specifically:

> A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides.
>
> The economic efficiency that should be promoted includes—
>
> (a) efficient investment in, or in connection with, a pipeline with which the service provider provides reference services; and
>
> (b) the efficient provision of pipeline services; and
>
> (c) the efficient use of the pipeline.

30. This specification of 'effective incentives in order to promote economic efficiency' in the RPP is entirely consistent with the incentive regulation approach. Incentive regulation provides an opportunity for the regulated utility to perform better than the regulator's ex ante forecasts of its costs. Subsequent savings are then shared between the utility and consumers. This is recognised as creating incentives for outcomes that are more efficient, and hence in the long term interests of consumers.

31. With regard to rate of return, the Australian Energy Market Commission has established the new allowed rate of return objective in the National Gas Rules (**NGR**):[13]

> The allowed rate of return objective is that the rate of return for a service provider is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services

32. In this context, the AEMC stated in its final rule determination that the new allowed rate of return objective is intended to be consistent with the National Electricity Objective (**NEO**), the NGO and the RPP:[14]

> The Commission has taken the opportunity in this final rule determination to explain how the new rules are to be interpreted. Most importantly, the new rules allow the regulator (and the appeal body) to focus on whether the overall rate of return meets the allowed rate of return objective, which is intended to be consistent with the NEO, the NGO and the RPP.

2.1.2.1 Other elements in the new National Gas Rule 87

33. The NGR 87 includes a number of sub-rules which refer to matters the regulator is to have 'regard' to, when determining the allowed rate of return, including:

> NGR 87(5) In determining the *allowed rate of return*, regard must be had to:

[12] Ibid.

[13] Australian Energy Market Commission 2012, *National Gas Rules*, www.aemc.gov.au, clause 87(3).

[14] Australian Energy Market Commission 2012, *Rule Determination: National Electricity Amendment (...) Rule 2012*, www.aemc.gov.au, 29 November, p. 23.

(a) relevant estimation methods, financial models, market data and other evidence;

(b) the desirability of using an approach that leads to the consistent application of any estimates of financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt; and

(c) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt.

NGR 87(7) In estimating the return on equity under subrule (6), regard must be had to the prevailing conditions in the market for equity funds.

NGR 87(11) In estimating the return on debt under subrule (8), regard must be had to the following factors:

(a) the desirability of minimising any difference between the return on debt and the return on debt of a benchmark efficient entity referred to in the *allowed rate of return objective* ;

(b) the interrelationship between the return on equity and the return on debt;

(c) the incentives that the return on debt may provide in relation to capital expenditure over the *access arrangement period*, including as to the timing of any capital expenditure; and

(d) any impacts (including in relation to the costs of servicing debt across *access arrangement periods*) on a benchmark efficient entity referred to in the *allowed rate of return objective* that could arise as a result of changing the methodology that is used to estimate the return on debt from one *access arrangement period* to the next.

34. In addition, the new NGR 87 sets out a number of additional requirements for the *allowed rate of return*, including that:

- it is to be determined such that it achieves the allowed rate of return objective (new NGR 87(2));
- subject to the rate of return objective (new NGR 87(2)), the allowed rate of return for a regulatory year is to be:

  a weighted average of the return on equity for the access arrangement period in which the regulatory year occurs and the return on debt for that regulatory year (new NGR 87(4)(a));

  determined on a nominal vanilla rate of return that is consistent with the estimate of the value of imputation credits (new NGR 87(4)(b));[15]

- results in a return on debt for a regulatory year which contributes to the achievement of the allowed rate of return objective (new NGR 87(8)) which is either the same in each year of the access arrangement period or which varies in each year through the application of an automatic formula (new NGR 87(9) and NGR 87(12));
- incorporates a return on debt that would be required by debt investors over a relevant time period (whether shortly before the access arrangement decision, or on average over an historical period, or some combination of the two approaches) (new NGR 87(10)).

2.1.3 Implications for the regulator

35. At the outset, given the requirements set out above, the anchor for any regulatory decision will be the overall regulatory framework that is considered to best deliver

[15] The specification of a vanilla WACC implies that tax liabilities must be estimated separately to the rate of return. On this basis, the requirement is for a 'post-tax' approach.

the requirements of the NGL, NGR, NGO, RPP and the allowed rate of return objective. The Authority considers that this framework may be informed by an objective function, and a number of constraints:

a) The primary objective is to achieve a rate of return for a service provider 'commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk in respect of the provision of reference services'.[16] Related objectives include a need to achieve the allowed rate of return:

   i. for each of the regulatory years;[17]

   ii. incorporating effective incentives to promote efficient investment;[18]

   iii. that is in the long term interests of consumers.[19]

b) A constraint is that uncertainty about the future, information asymmetries, and circularity problems complicate the task of determining the rate of return. On this basis, it is recognised that the regulator needs only to estimate a cost of debt and cost of equity which gives the efficient service provider 'reasonable opportunity' to recover its costs over the regulatory period.[20]

c) A further constraint is a requirement to minimise transaction costs for the service provider and regulator.

36. The current regulatory approach assumes that the efficient firm that meets the above objectives provides the 'benchmark'. The 'benchmark efficient firm' informs the cost building blocks for each regulatory decision.

37. An implication of point a) is that the rate of return must remunerate the efficient financing costs of the service provider over the lives of the assets, in terms of net present value.[21]

38. The implication of the efficiency element of point a) is that the benchmark firm is assumed to be on or near the efficiency frontier, consistent with the performance and cost structure of an efficient service provider. The efficient firm would be part of the portfolio of efficient assets held by an investor:

- The benchmark firm's efficient cost of finance will reflect the prevailing conditions in capital markets for the cost of debt and equity, taking into account its risk. The resulting discipline on its cost structure is entirely consistent with that faced by firms in competitive markets, where prices, and returns, are set with reference to the prevailing cost of capital.

- An implication of adopting the benchmark efficient firm is that the actual decisions of the service provider may differ (and often will differ) from the

16 National Gas Rule 87(3) – the allowed rate of return objective.

17 National Gas Rule 87(4).

18 National Gas Law 24(3) – a Revenue and Pricing Principle – states that the 'a service provider should be provided with effective incentives to promote economic efficiency with respect to reference services'. Note that the AEMC has stated that 'The Commission has taken the opportunity in this final rule determination to explain how the new rules are to be interpreted. Most importantly, the new rules allow the regulator (and the appeal body) to focus on whether the overall rate of return meets the allowed rate of return objective, which is intended to be consistent with the NEO, the NGO and the RPP' (Australian Energy Market Commission 2012, *Rule Determination: National Electricity Amendment (...)Rule 2012*, www.aemc.gov.au, 29 November, p. 23.

19 As per the National Gas Objective.

20 National Gas Law 24(2) – a Revenue and Pricing Principle – states that the 'service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs'.

21 This is consistent with the 'NPV=0' condition. For more detail, refer to Appendix 3 of the Rate of Return Guidelines Explanatory Statement.

benchmark firm. However, under incentive regulation the regulator does not compensate the regulated service provider for its actual decisions, but compensates it *as if* it were operating efficiently. If the service provider is not actually operating efficiently relative to the benchmark then that is a matter for management and the shareholders of the service provider.

- In addition, the benchmark cannot be purely hypothetical. The benchmark should be based on the actual costs and risks faced by an efficient service provider.
- The benchmark approach provides high powered incentives for the regulated business. If the regulated business is able to exceed the benchmark performance, it is able to retain any increased profits during the regulatory period. If the regulated firm fails to achieve the benchmark, then its bears the relevant losses.

39. The efficient firm would provide reference services in a way which meets consumers' preferences with regard to price, quality, reliability, safety and security, thereby meeting the requirement of a)(iii).

40. An implication of the subsidiary objective of point a)(i) relating to regulatory years is that the allowed rate of return objective looks forward to the actual regulatory years of the access arrangement period.

41. An implication of the subsidiary objective of point a)(ii) relating to effective incentives is that best practice regulation will generally set an estimated return ex ante, and then allow the firm to capture a portion of any subsequent out-performance. A portion of the out-performance resulting from this incentive regime ultimately may be shared with consumers.

42. An implication of point a)(i) and point b) is that the regulator sets the rate of return based on the most 'reasonable' predictors of the cost of debt and the cost of equity for the future regulatory years.[22] One advantage of establishing incentive regimes under point a)(ii), noted above, is that these may be structured to help the regulator to observe the true finance costs of the firm, thereby assisting the regulator to overcome information asymmetries.

43. An implication of point c) is that regulators are reluctant to revisit the returns to the firm too frequently, particularly where this increases transactions costs for both the regulator and the firm, or where it reduces the power of any incentives associated with an ex ante approach. Current practice is to set the regulated return for a five year period.

2.2 Criteria for application of regulatory discretion

44. The Authority considered in its Consultation Paper that 'criteria' would help to guide its regulatory discretion in determining the best approach for meeting the allowed rate of return objective and related NGR for the rate of return. The AER proposed similar 'principles' in its Issues Paper.[23]

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[22] National Gas Law 24(2) – a Revenue and Pricing Principle – states that 'a service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs...'.

[23] Australian Energy Regulator 2012, *Better Regulation: Rate of Return Guidelines: Issues Paper*, December 2012, www.aer.gov.au/node/18859, p. 15.

45. These are informed by the requirements of the NGL, the NGO, the NGR and the allowed rate of return, set out above.

2.2.1 Submissions

46. Submissions set out a range of general comments in relation to the criteria that were proposed in the Authority Consultation Paper and the principles that were proposed in the AER Issue Paper.

47. A number of service providers consider that sufficient criteria are already contained within the new NGR – at NGR 87 (5) – (12). For example, ATCO stated that:[24]

> ATCO is of the view that Rule 87 already provides the criteria which guide rate of return determination. The NGL and the NGR do not call for, or require, criteria which lie outside the regulatory regime.

48. Similarly, DBP considered that the Authority's proposed principles or decision framework to be neither necessary nor consistent with the allowed rate of return objective, suggesting that:[25]

> Rule 87 already provides criteria to guide rate of return determination; the NGL and NGR do not call for, or require, criteria which lie outside of the regulatory regime.

49. APIA, on the other hand, considered that:[26]

> A principles based approach is appropriate to ensure the methodology used to determine the allowed rate of return meets the objective and is applied consistently and transparently.

50. However, APIA believes that the principles should not supersede or reorder the rules in any way:[27]

> Any further subset of principles regarding the rate of return developed by a regulator should be explicitly referenced back to the principles contained in the rules and be focussed on how the decision maker intends to ensure its thought process in making rate of return decisions is rigorous and meets the requirements of the rules.
>
> It is not useful to for any principles developed for the Guideline to repeat any matters dealt with in higher order objectives.
>
> In addition, APIA would also caution against the development of principles which gives greater priority to one or some of the principles in the rules at the expense of other principles in the rules.

51. ENA supported a 'principled' approach, although considered that the term 'considerations' would be a better descriptor than 'principles'.[28] ENA also considers that:

> The listed considerations should be identified in a manner consistent with (and cannot supplant) the requirement in the new Rules that return on capital decisions achieve the *allowed rate of return objective*. The overall objectives for gas and electricity laws, and

[24] ATCO Gas Australia 2013, *Response to Authority consultation paper on rate of return guidelines*, www.erawa.com.au, Section 4.

[25] DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, p. 21.

[26] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, p. 20.

[27] Ibid.

[28] Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.gov.au, Att. 1, p. 8.

> the revenue and pricing principles, in the primary legislation should also inform how the *allowed rate of return objective* is met.
>
> None of the itemised considerations should operate in a binary or "absolute" way. A model should not, for example, be included or excluded on the basis that it "passes" or "fails" a particular itemised consideration. Nor should the list of considerations as a whole operate as a 'score sheet' with a model being preferred because it has "satisfied" five considerations while another has only "satisfied" four. Rather the list would constitute considerations upon which AER decisions should be made.
>
> The ENA sees the set of considerations evolving over time to reflect a collation of regulatory best practice. It does not consider that the list of considerations should remain static, be interpreted in a strict legal sense, or be applied in a mechanical "check-box" manner.

52. The MEU supported the notion of principles, but noted that these 'should not be used to close off issues that will assist in ensuring the outcomes will be demonstrably efficient'.[29] MEU considered that the principles should clearly set out and be linked back to the allowed rate of return objective – in particular that the principles should deliver outcomes that are efficient and that are in the long term interests of consumers.

53. A number of submissions also proposed changes to the suggested principles of the Authority and AER. These proposed changes are referred to in the following section.

2.2.2 *Considerations of the Authority*

54. The Authority notes that some submissions did not consider that criteria were necessary. These submissions set out the view that the revised NGR already contained sufficient criteria for the exercise of regulatory judgment.

55. However, it is evident that the requirements of the allowed rate of return objective and the related NGR are quite broad. In addition, the elements that the regulator is required to have 'regard' to are not necessarily prescriptive of particular outcomes. Rather they set out the matters that the regulator is required to take into account when making a determination.

56. It is feasible that various relevant estimation methods, financial models, market data and other evidence may meet some, but not all, of the provisions of the new NGR 87, that the Authority is required to have regard to. To this end, it is likely that these potential approaches may address the NGR provisions well in some areas, and less well in other others.

57. This broad framework permits the regulator considerable flexibility in determining the allowed rate of return. To provide a greater degree of certainty and transparency for its future determinations, the Authority considers it helpful to outline a set of criteria that will guide stakeholders as to its decision making with respect to assessing or determining what approaches, methods and sources of information can be used to satisfy the rate of return objective.

58. The Authority has reviewed the criteria set out in the Consultation Paper. The detail of this review is at Appendix 4.

[29] Western Australian Major Energy Users 2013, *MEU response to AER Issues Paper,* www.erawa.gov.au, p. 9.

2.2.2.1 Implementation

59. ATCO in its submission to the Authority interpreted the Authority's Consultation Paper as suggesting that the criteria be used as a type of filter to remove methods or data from its consideration.[30] This was based on the logic flow of Figure 1 in the Consultation Paper. This inference was intended. The Authority considers that the guidelines need to 'filter' out those estimation methods, financial models, market data and other evidence that are not considered to meet the requirements of the NGL and the NGR, or which are judged to not perform as well in meeting those requirements as preferred methods. This approach is intended to increase certainty for stakeholders as to how the review of access arrangement proposals will be conducted.

60. 'Ideal' methodologies – comprising estimation methods, financial models, market data and other evidence – would strongly meet all the criteria. However, this may not always occur in practice.

61. A methodology would need to be broadly consistent with the criteria to be considered appropriate. Some methodologies may perform better on some criteria and less well on others, and yet may still be considered appropriate. Accordingly, the assessment is whether, on balance, a methodology is consistent with the criteria.

62. Nevertheless, a methodology would need to pass a threshold of adequacy to be considered appropriate. To the extent that a methodology failed the adequacy threshold, then it would be rejected. This rejection would be consistent with the AEMC's purpose for the guidelines, which is to narrow down the set of methodologies that are considered to meet the NGL and the NGR:[31]

> In order for the guidelines to have some purpose and value at the time of the regulatory determination or access arrangement process, they must have some weight to narrow the debate.

63. Once over the threshold for adequacy, then, as noted, any particular methodology may meet the criteria to a greater or lesser degree. With this mind, the criteria would then be used evaluate the methodology, in terms of how it performed in meeting the requirements of NGR87, and the NGL and NGR more broadly. In this way, the criteria are intended to inform and provide a framework for the regulator's decision making, and thereby provide a level of transparency around its exercise of judgement.

64. As a framework for the regulator's decision making, the criteria must draw their relevance from, and be consistent with, the NGL and the NGR. APIA notes in this context:[32]

> In approaching the task of developing the principles, it is appropriate to be cognisant of the hierarchy of objectives that must be met when determining the allowed rate of return. In the case of gas decisions, the overarching priority is meeting the National Gas Objective (NGO). Under the NGO sits the Revenue and Pricing Principles (R&PP). Then there are the requirements of the National Gas Rules, primarily set out in rule 87.

[30] ATCO Gas Australia 2013, *Response to Authority consultation paper on rate of return guidelines*, www.erawa.com.au, Section 3.

[31] Australian Energy Market Commission 2012, *Rule Determination, National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012*, www.aemc.gov.au, 29 November, p. 58.

[32] The Australian Pipeline Industry Association 2013, Rate of Return Review, www.erawa.gov.au, p. 40.

> A high level set of principles for the rate of return are already set out by 87(5) of the NGR and its NER equivalent. This is further supported by specific principles for the return on equity (87(6)-(7)) and debt (87(8)-(12)) already provided.
>
> Any further subset of principles regarding the rate of return developed by a regulator should be explicitly referenced back to the principles contained in the rules and be focussed on how the decision maker intends to ensure its thought process in making rate of return decisions is rigorous and meets the requirements of the rules.
>
> It is not useful for any principles developed for the Guideline to repeat any matters dealt with in higher order objectives.
>
> In addition, APIA would also caution against the development of principles which gives greater priority to one or some of the principles in the rules at the expense of other principles in the rules.

65. The Authority agrees that the criteria should not supplant the NGL and the NGR; rather, they will provide guidance on how the regulator will achieve the requirements of the NGL and NGR, particularly where the regulator is exercising discretion.

66. With this in mind, in the criteria, the Authority does not repeat the NGR in the key criteria sub-heading. At the same time, the Authority links the criteria back to the requirements of the NGL and the NGR, to ensure that there is a sound basis for each of the criteria for the guidance of regulatory judgment.

2.2.3 Draft Guidelines

67. The Authority considers that it will need to exercise judgment in meeting the requirements of the NGL and the NGR, and that criteria would help to provide a framework for that exercise of regulatory judgment, while enhancing transparency and predictability for stakeholders.

68. The following criteria are not intended to supplant the NGL and NGR. Rather they are subordinate to the requirements set out in the two instruments. That said, the Authority considers it desirable if the proposed rate of return methods are:

- driven by economic principles
  - based on a strong theoretical foundation, informed by empirical analysis;
- fit for purpose;
  - able to perform well in estimating the cost of debt and the cost of equity over the regulatory years of the access arrangement period;
- implemented in accordance with best practice;
  - supported by robust, transparent and replicable analysis that is derived from available, credible datasets;
  - based on quantitative modelling that is sufficiently robust as to not be unduly sensitive to small changes in the input data;
  - based on quantitative modelling which avoids arbitrary filtering or adjustment of data, which does not have a sound rationale;
- capable of reflecting changes in market conditions and able to incorporate new information as it becomes available;
- supportive of specific regulatory aims; and thereby:

- recognise the desirability of consistent approaches to regulation across industries, so as to promote economic efficiency;
- seek to achieve rates of return that would be consistent with the outcomes of efficient, competitive markets;
- ensure that the net present value of returns is sufficient to cover a service providers' efficient expenditures (the 'NPV=0' condition);
- provide incentives to finance efficiently;
- promote simple approaches over complex approaches where appropriate;
- promote reasoned, predictable and transparent decision making;
- enhance the credibility and acceptability of a decision.

3 Overall rate of return

69. The Authority is required to adopt a 'nominal vanilla' weighted average cost of capital (**WACC**) in developing the rate of return for the benchmark efficient entity.[33]

70. A vanilla WACC would not include any adjustment for tax impacts, for example, in relation to the effect of imputation credits on the rate of return. The impact of tax on the returns would need to be accounted for separately, as an explicit deduction from the relevant cash flows. A vanilla WACC is therefore a 'post-tax' framework.

71. The nominal vanilla WACC provides for a simple weighted average of the nominal post-tax return on equity and the nominal return on debt. A range of issues may considered in this context, including:

- the term of the return on equity and the return on debt;
- whether to adopt ranges or point estimates; and
- reasonableness checks.

72. In what follows, each of these elements is considered.

3.1 Submissions

73. Submissions made little comment on the approach to incorporating the vanilla WACC, other than to note that it was a prescriptive requirement of the National Gas Rules (**NGR**).[34]

74. ATCO observed that a nominal WACC must be derived as a simple weighted average of the nominal post-tax return on equity and the nominal return on debt, with the weights to reflect the proportion of equity and debt in total financing, as reflected in the gearing.[35]

75. Most submissions were silent on the issue of the term of the return on equity and on debt. However, Goldfields Gas Transmission (**GGT**) stated that:[36]

- the Authority's bond-yield approach – by estimating the debt risk premium for a sample of bonds with an average remaining term to maturity of five years – will systematically underestimate the cost of debt applicable to the service provider;
- imposing a five year term for the return on debt would cause firms to restructure their debt portfolios to match the benchmark term;
- imposing the NPV=0 principle is tantamount to the regulator dictating the financing arrangement of the firm, which is beyond its duties.

[33] NGR 87(4)..

[34] See for example, Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, p. 11.

[35] ATCO Gas Australia 2013, *Response to ERA consultation paper on rate of return guidelines*, www.erawa.com.au, p. 16.

[36] Goldfields Gas Transmission 2013, *Submission to Economic Regulation Authority Consultation Paper*, www.erawa.com.au, p. 24.

76. With regard to point estimates of the rate of return versus ranges, submissions generally took the position that the regulator would develop a point estimate derived from its judgement informed by a range based on different estimation methods, models data and other evidence.

77. Some submissions also considered that reasonableness checks would assume less importance in this context.[37]

3.2 Considerations of the Authority

78. The Authority notes that the NGR specify the WACC that is to apply in any regulatory year is to be comprised of a weighted average of:[38]

- the return on equity for the access arrangement period in which that regulatory year occurs; and
- the return on debt for that regulatory year.

79. This specification is in turn 'subject to' the requirement that it achieves the allowed rate of return objective.[39] This means that the estimate of the return on equity and the return on debt 'is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services'.[40]

80. Issues relating to the definition of the benchmark firm and the approach to addressing the requirement for a similar degree of risk are therefore important considerations. These issues are considered in the next chapter.

3.2.1 Implementing a post tax nominal vanilla rate of return

81. The Authority applied a pre-tax real estimate of the rate of return in its recent decisions on access arrangements for the Dampier to Bunbury Natural Gas Pipeline and the Mid-West and South-West Gas Distribution System. The Authority also accepted a proposal to apply a pre-tax nominal estimate of the rate of return by GGT for the Goldfields Gas Pipeline.

82. More recently, the Authority adopted an explicit post-tax approach to deriving the return on equity in its Western Power decision.[41] This approach estimated tax liabilities as nominal cash flows, before deflating these for inclusion within the Authority's real building block model. A real vanilla post tax estimate of the return on equity was then utilised for determining the WACC. As such, the Authority's approach was a 'hybrid' of nominal and real building block models.

83. The Authority recognises that its previous approaches to estimating the rate of return are not consistent with the requirements under the new NGR 87.

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[37] Electricity Networks Association 2013, *ERA Consultation Paper – Rate of Return Guidelines*, www.erawa.com.au, Attachment A, p. 26.

[38] NGR 87(4)(a).

[39] NGR 87(2).

[40] NGR 87(3).

[41] Economic Regulation Authority 2012, *Further Final Decision on Proposed Revisions to the Access Arrangement for the Western Power Network*, www.erawa.com.au.

84. The Authority will need to apply an explicit nominal post tax modelling framework for its future decisions. To this end, the Consultation Paper noted that the Authority could adopt the Australian Energy Regulator's (**AER**) Post Tax Revenue Model (**PTRM**). The AER's PTRM provides a full nominal building block approach to estimating the revenue requirement for the service provider.

85. The PTRM's nominal framework means that the building block revenue forecasts include estimates of expected inflation. The revenue allowances are therefore estimated in nominal dollar terms. In particular, when calculating the 'rate of return on capital' element in the building block, the regulatory asset base for is indexed in each year by expected inflation. This is multiplied by a nominal rate of return that includes expected inflation.

86. The PTRM deals with tax explicitly through operating cash flows, which is therefore consistent with the use of the nominal vanilla WACC.

87. The Authority considers that the AER's PTRM, or a very similar model, will provide a basis for future access arrangement determinations.[42] The PTRM will enable the Authority to utilise a nominal vanilla WACC.

3.2.2 Components of the rate of return

88. As noted above, the new NGR specify that the rate of return should be a weighted average of the cost of equity and cost of debt (new NGR 87(4)(a)). This approach to estimating the overall rate of return is a 'bottom up' approach, which combines separate estimates for the cost of equity and the cost of debt.

89. The resulting weighted average cost of capital (**WACC**) for a benchmark efficient entity represents the competitive rate of return that an entity must earn on its existing asset base in order to satisfy its creditors, shareholders and other providers of capital. In its simplest 'vanilla' form, the WACC may be expressed as:

$$WACC_{vanilla} = E(r_e)\frac{E}{V} + E(r_d)\frac{D}{V} \tag{1}$$

where

$E(r_e)$ is the expected return on equity;

$E(r_d)$ is the expected return on debt;

$\frac{E}{V}$ is the proportion of equity in total financing (comprising equity and debt; and

$\frac{E}{D}$ is the proportion of debt in total financing.

90. The approach to estimating the gearing, the return on equity and the return on debt are discussed in more detail in following chapters.

[42] As noted in the Authority's Consultation Paper, there will be a number of transitional issues in moving from a real model to a nominal model, particularly with regard to tax depreciation. However, these issues are outside the scope of this Rate of Return Guideline.

3.2.3 The term of the WACC

91. The NGR require the Authority to have regard to 'the desirability of an approach that leads to the consistent application of any estimates of financial parameters, that are relevant to the estimates of, and are common to, the return on equity and the return on debt'.[43]

92. The present value principle is a key consideration for establishing the appropriate term for the return on equity and the return on debt. The present value principle requires that the present value of a service provider's revenue stream should match the present value of the expenditure stream (plus or minus any efficiency rewards or penalties).[44] This will result in the so-called Net Present Value equals zero condition (NPV=0).

93. The Authority is of the view that the regulatory return is likely to most closely match to the NPV=0 condition when the term of components of the return on equity and the return on debt is set equal to the length of the regulatory period (for more detail, refer to Appendix 2).

94. This outcome is in the long term interests of consumers, as it is consistent with economic efficiency. The Authority considers that the condition is met when the estimates of the return on equity and the return on debt are based on the prevailing conditions at the start of the period. This view accords with that of Lally, who considered the application of the present value principle under conditions of risk, noting:[45]

> In summary, the Present Value principle applies equally to risk free and risky situations and, in the latter case, requires both a risk free rate and a risk premium that are defined over the regulatory period and based upon conditions prevailing at the start of that period.

95. The Authority notes that DBP considers that the 'NPV = 0' principle does not apply to firms with a price cap.[46] DBP submitted that the literature relates this principle to firms with rate of return regulation. DBP argued that under a price cap, the regulated firm takes on demand risk, and is not compensated for any difference in actual outcomes to forecast demand outcomes.

96. DBP also noted that where firms are unable to hedge the regulated return on debt exactly, then there will be some violation of the 'NPV = 0' principle.

97. The Authority considers that under a price cap, there may be under- and over-estimates of the allowed revenue due to the demand risk. Similarly, where firms have some basis risk from imperfect hedging, there will be some under- and over-estimates as well.

98. However, the Authority is of the view that these under- and over- estimates do not detract from the principle that the regulator should be seeking to ensure that 'NPV=0 over the life of the regulated asset. The Authority considers that this principle is required to be addressed to ensure that the long term interests of consumers are met. The analyses from Lally and Davis have demonstrated that

[43] NGR 87 (5)(b).

[44] Lally M .2012, *The risk free rate and the present value principle*, www.aer.gov.au, p. 8.

[45] Lally M. 2013, *The Present Value Principle: Risk, Inflation, and Interpretation*, www.aer.gov.au, p. 6.

[46] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 16.

this 'NPV=0' principle is most closely met where the term of the debt used for estimating the return on debt is the same as the term of the regulatory period (see Appendix 2).

99. The Authority therefore considers that the term of the estimates for the rate of return should be consistent with the term of the regulatory period.

100. Accordingly, as the term of the regulatory period for the Authority's gas pipeline and networks decisions is five years, the term of its estimates for the rate of return will be five years.

3.2.4 Point estimates or ranges for estimates?

101. Under the new NGR, there is now greater scope for the regulator to use judgment. This exercise of judgment may extend to the determination of point estimates within potential ranges for the rate of return. The option of using ranges, or judgment to determine point estimates within ranges, can occur at different 'levels' of the estimation process. The key 'levels' are the estimation of the:

- parameter values;
- return on equity or the return on debt;
- overall rate of return.

102. The Authority considers each of these levels in what follows.

3.2.4.1 The parameter level

103. The Authority has in the past utilised ranges to inform estimates at the parameter level. For example, the Authority in its Western Power decision, considered ranges for the benchmark credit rating, the market risk premium and the equity beta.

104. In this context, ranges have either been used to combine estimates from a number of different approaches, or to represent uncertainty determined through statistical analysis.

105. For example, in estimating the market risk premium, the Authority in its recent decision on Western Power's access arrangement considered four different approaches. These approaches gave overlapping estimates, which together delivered a range, from which it selected a single point estimate for use in estimating the return on equity.[47]

106. Similarly, in estimating the equity beta, the Authority undertook statistical analysis of market data for a sample of benchmark comparators, from which it established a range. The Authority then used its judgment to select a single point estimate.[48]

[47] Economic Regulation Authority 2012, *Final Decision on Proposed Revisions to the Access Arrangment for the Western Power Network*, www.erawa.com.au, p. 379.

[48] Economic Regulation Authority 2012, *Final Decision on Proposed Revisions to the Access Arrangment for the Western Power Network*, www.erawa.com.au, p. 398.

107. A range is not always required. For example, the gearing ratio has been based on a single point estimate derived from the average of observations from comparator firms.

108. The Authority notes that other Australian regulators adopt similar approaches for determining parameter estimates.

109. The Authority is of the view that establishing ranges for parameters may be appropriate in some circumstances, while elsewhere a single point estimate may be readily obtained. The Authority considers that it is reasonable to continue with this approach at the parameter level.

3.2.4.2 The return on equity and the return on debt

110. The Authority's practice to date has been to establish single point estimates for each parameter, which are then utilised to estimate the return on equity and the return on debt.

111. The alternative could be to utilise ranges for parameters, which then inform a range for the return on equity and the return on debt.

112. The Authority considers that use of single point estimates for parameters is preferred. Point estimates allow stakeholders to compare readily outcomes with other reference points, for example from other sources. In the case of a particular estimation method or financial model, this use of point estimates for parameters would then necessarily lead to a single point estimate for the return on equity and the return on debt. The Authority considers that this gives greater clarity in terms of the means used to estimate the return on equity and the return on debt, which might otherwise be lost if the point estimate was determined and the higher level.

113. However, where multiple estimation methods, financial models, market data or other evidence are used, then this could lead to a range for the return on equity or the return on debt. In this case, the Authority considers that it would determine a point estimate at the level of the return on equity or the return on debt. Again, such point estimates would provide for ready comparison between sources, and for clarity of approach.

114. The Authority therefore will establish point estimates at the parameter level, whether determined from within a range, or derived directly. Such point estimates would then facilitate a single point estimate outcome from each estimation method or financial model.

115. Similarly, the Authority will seek to establish point estimates at the level of the return on equity and the return on debt, whether these are derived from a single point estimate, or from a range informed by multiple estimation methods, financial models, market data or other evidence.

116. Where single point estimates are derived from a range, the Authority recognises that it may be appropriate in some circumstances to adopt a formal weighting approach to inform the final estimate. In other cases, the Authority will need to exercise its judgment, articulating any reasons that inform its decisions.

3.2.4.3 The overall rate of return

117. The development of single point estimates for the return on equity and the return on debt will lead to a single point estimate for the rate of return. A single point estimate will be facilitated by the single point estimate of the gearing level.

3.2.5 Requirement to meet the allowed rate of return objective

118. Under the NGR, additional considerations are also required to be taken into account when combining the estimates of the expected return on equity and debt through the WACC, specifically:

- the estimate of the rate of return derived from the bottom up WACC approach needs to be assessed broadly against the allowed rate of return objective;[49] and
- regard must be given to the 'interrelationship between the return on equity and the return on debt' (NGR 87(11)(b)) and 'any inter-relationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt' (NGR 87(5)(c).

119. First, the need to account for the broad rate of return objective suggests that some form of broad cross check is required to be undertaken on the results of the bottom up approach to estimating the rate of return. That is, does the WACC estimate result in outcomes which are broadly in line with that which may be observed for benchmark efficient entities with a similar degree of risk?

120. On this basis, it is feasible that cross-checking approaches could be undertaken to assess the sensibility of the resulting WACC estimate. The range of cross check approaches are considered in greater detail in chapter 7.

121. The Authority is open to exercising tests of reasonableness for the outcomes of the models or approaches. The Authority notes that tests of reasonableness need to be interpreted with care, to ensure that any comparisons are made on a transparent and consistent basis.

3.3 Draft Guidelines

122. The following elements will be adopted by the Authority for its future regulatory decisions.

3.3.1.1 A nominal post tax model

123. The Authority will apply an explicit nominal post tax modelling framework for its future decisions.

124. The Authority considers that the AER's PTRM, or a similar model, will provide a basis for future access arrangement determinations.[50] The PTRM will enable the Authority to utilise a nominal vanilla WACC.

[49] As noted above, NGR 87(4) states that the WACC is 'subject to' NGR 87 (2), which is that the allowed rate of return is to be determined such that it achieves the allowed rate of return objective. The allowed rate of return objective set out at 87(3) states that the 'rate of return is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in the provision of reference services'.

125. The PTRM deals with tax explicitly through operating cash flows, which is therefore consistent with the use of the nominal vanilla WACC.

3.3.1.2 Components of the rate of return

126. The Authority will adopt a weighted average cost of capital (**WACC**) for a benchmark efficient entity in its simplest 'vanilla' form, expressed as:

$$WACC_{vanilla} = E(r_e)\frac{E}{V} + E(r_d)\frac{D}{V} \quad (2)$$

where

$E(r_e)$ is the expected return on equity;

$E(r_d)$ is the expected return on debt;

$\frac{E}{V}$ is the proportion of equity in total financing (comprising equity and debt; and

$\frac{E}{D}$ is the proportion of debt in total financing.

3.3.1.3 The term of the WACC

127. The term of the estimates for the rate of return will be consistent with the term of the regulatory period.

128. Accordingly, as the term of the regulatory period for the Authority's gas pipeline and networks decisions is five years, the term of its estimates for the rate of return will be five years.

3.3.1.4 Point estimates or ranges?

129. The Authority will establish point estimates at the parameter level. These point estimates may be determined from within a range, or derived directly. Such point estimates would then inform a single point estimate for an estimation method or financial model.

130. Similarly, the Authority will seek to establish point estimates at the level of the return on equity and the return on debt. These point estimates may be derived from a single estimation method, or from a range informed by multiple estimation methods, financial models, market data or other evidence.

131. Where single point estimates are derived from a range, the Authority recognises that it may be appropriate in some circumstances to adopt a formal weighting approach to inform the final estimate. In other cases, the Authority will need to exercise its judgment, articulating any reasons that inform its decisions.

132. The use of a single point estimate for the return on equity and the return on debt will lead to a single point estimate for the rate of return. The single point estimate

[50] As noted in the Authority's Consultation Paper, there will be a number of transitional issues in moving from a real model to a nominal model, particularly with regard to tax depreciation. However, these issues are outside the scope of this Rate of Return Guideline.

of the rate of return will be facilitated by a single point estimate of the gearing level.

3.3.1.5 Requirement to meet the allowed rate of return objective

133. The Authority will consider appropriate tests of reasonableness for the outcomes of the WACC models or approaches. The Authority notes that tests of reasonableness need to be interpreted with care, to ensure that any comparisons are made on a transparent and consistent basis.

4 The benchmark efficient entity and compensation for risk

134. The allowed rate of return objective is set out at NGR 87(3):[51]

> 87(3) The *allowed rate of return objective* is that the rate of return for a service provider is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services (the *allowed rate of return objective*).

135. The wording of the allowed rate of return objective requires that the rate of return is to be based on the:

- efficient financing costs; of
- a benchmark efficient entity; with
- a similar degree of risk as the service provider in respect of the provision of reference services.

136. Each of these elements is considered in what follows.

4.1 Efficient financing costs

137. The Authority noted in its Consultation Paper that the new NGR 87 refines the financing cost requirements that were implicit in the previous rule. The Authority considered that the Australian Energy Market Commission's view – that efficient financing costs 'allow a service provider to attract the necessary investment capital to maintain a reliable energy supply while minimising the cost to consumers' – is consistent with its current approach utilised for the rate of return.[52]

138. The Authority also noted in its Consultation Paper that the benchmark weighted average cost of capital (**WACC**) – used currently – targets a cost minimising mix of equity and debt for the benchmark firm. Consistent with this approach, NGR 87(4) requires that the allowed rate of return be derived from a WACC, albeit subject to the primacy of the allowed rate of return objective (through NGR 87(2)).

4.1.1 Submissions

139. ATCO is of the view that 'efficient financing costs are the lowest costs of financing reliable service provision at the standards required by the regulatory regime'.[53]

140. DBP in its submission included APIA's submission to the AEMC, which suggested that the term 'efficient financing costs' is new in the regulatory sphere and does not have a recognised meaning. However, APIA considered that efficient financing costs would be the 'lowest sustainable cost for obtaining debt and equity

[51] Australian Energy Market Commission 2012, *National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012 No. 3,* www.aemc.gov.au, 87(3).

[52] Economic Regulation Authority 2012, C*onsultation Paper: Guidelines of the Rate of Return for Gas Transmission and Distribution Networks*, www.erawa.com.au, p. 11.

[53] ATCO Gas Australia 2013, *Response to Authority consultation paper on rate of return guidelines*, www.erawa.com.au, Section 4.5, p. 31.

necessary for the business to operate efficiently in the sense of economic efficiency'.[54]

4.1.2 Considerations of the Authority

141. Network infrastructure requires large investments in physical assets. The returns on those assets will be spread over the associated long economic lives.

4.1.2.1 Efficient financing

142. Productive investments yield returns that offset their costs. This rate of return may be compared with those for alternative competing investments, once adjusted for risk. Riskier investments tend to have a higher cost of funding, both for equity and debt. The higher funding costs account for expectations either of the potential for under-performance; or of greater volatility in returns over time.

143. Economic efficiency for the economy as a whole occurs when the return on funds invested in the marginal risky project just balances the supply of capital at any point in time.[55] The resulting risk adjusted rate of return is the efficient market rate of return.

144. On this basis, efficient financing costs will be consistent with the promotion of economic efficiency (see Chapter 2 for more detail on the Authority's consideration with regard to economic efficiency requirements of the National Gas Law and the NGR). The requirement for efficient financing costs is consistent with the broad efficiency considerations that the regulator is required to account for under the National Gas Objective and the Revenue and Pricing Principles.[56]

145. A necessary condition for financing costs to be efficient is that they are consistent with efficient financing costs applying elsewhere in the economy, taking account of risk. This suggests that the regulator, in seeking to achieve the requirements of the allowed rate of return objective, is required to look to financial markets and prevailing conditions for evidence as to efficient financing costs. This has been the practice to date.

146. While this may appear straightforward, the regulator needs to be mindful of a number of challenges in observing outcomes from financial markets.

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[54] DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, Att. 2 (APIA 2012, *Economic Regulation of Network Service Providers*), p. 7.

[55] This is a simplistic interpretation of investment theory, but captures the important underlying principle. Underpinning this statement is the body of neoclassical macroeconomic theory, which is reflected in the ISLM model. In this model, investment and saving are equilibrated by the interest rate.

[56] The Authority notes in this context that the explicit intent of the NGL and the NGO was to promote economic efficiency in the long term interests of consumers (see National Gas (South Australia) Bill 2008, *Second Reading Speech*, www.ret.gov.au, p. 4):

> The national gas objective is to promote efficient investment in, and efficient use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, reliability and security of supply of natural gas.
>
> The national gas objective is an economic concept and should be interpreted as such.
>
> The long term interest of consumers of gas requires the economic welfare of consumers, over the long term, to be maximised. If gas markets and access to pipeline services are efficient in an economic sense, the long term economic interests of consumers in respect of price, quality, reliability, safety and security of natural gas services will be maximised. By the promotion of an economic efficiency objective in access to pipeline services, competition will be promoted in upstream and downstream markets.

147. First, it is often the case that information derived from markets is conditioned by the model used to interpret observations. As such, the performance of the resulting empirical assessment of financial market costs often cannot be separated from the performance of the underlying theoretical model. It is for this reason that any estimate of the rate of return should be judged on its theoretical soundness, as well as its performance, in line with the criteria set out in chapter 2.

148. Second, there is a significant debate about the underlying efficiency of financial markets, particularly the degree to which market information is reflected in returns.[57] While this is an important theoretical debate, there is little alternative as a regulator than to accept that financial markets do obtain and incorporate information on investment prospects, up to the point where it is cost effective to do so. Despite inter-temporal lags in adjustment and periodic distortions in effective functioning, financial markets ultimately provide a strong basis for estimating efficient financing costs. Importantly, the prevailing costs of funds in financial markets are faced by all firms in the economy, which is a key consideration for a regulator, given the efficiency objectives referred to above.

149. Third, there are also potential issues with regard to the depth of markets, which can create difficulties for estimating actual market outcomes over short periods, particularly where parameters are more volatile. Practical means to address these problems involve either:

- extending the period of observation, giving more of a historic average; or
- drawing on a broader data set.[58]

150. The criteria relating to good practice, robustness and transparency are important considerations in assessing options to overcome these issues.

151. Overall, the Authority concludes that the cost of capital observed in the debt and equity markets provides the main reference point for a regulator seeking to establish the efficient financing costs of a regulated entity. As noted by Brealey and Myers, ‘the concept of an efficient [financial] market is simple and generally supported by the facts’.[59]

4.1.2.2 Domestic or international financial markets

152. In seeking to observe the efficient financing costs of regulated firms operating in Australia, the question arises as to the degree to which international capital

[57] Fama states that the weaker, economically sensible version of the market efficiency hypothesis relates to the idea that ‘security prices fully reflect... information to the point where the marginal benefits of acting on information (the profits to be made) do not exceed the marginal costs’ (Fama E. F. 1991, Efficient Capital Markets: II, *The Journal of Finance*, Vol. XLVI, No. 5, p. 1575).

[58] For example, see DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, Att. 4 (Brattle Group 2013, *Estimating the Cost of Debt*), p. 11 & p. 20.

[59] Brealey R.A. and Myers S.C. 1996, *Principles of Corporate Finance*, McGraw-Hill, p. 346.

It is worth noting in this context the ‘efficient markets hypothesis’ has been strongly debated in recent decades (Dimson E. and Mussavian M. 2000, Market Efficiency, *The Current State of Business Disciplines*, Vol. 3, p. 967):

> The last two decades have witnessed an onslaught against the efficient markets hypothesis. Yet as Roll (1994) observes, it is remarkably hard to profit from even the most extreme violations of market efficiency. Stock market anomalies are only too often chance events that do not persist into the future. The importance of the efficient markets hypothesis is demonstrated by the fact that apparently profitable investment opportunities are still referred to as “anomalies”. The efficient markets model continues to provide a framework that is widely used by financial economists.

markets influence the cost of capital in Australia. Relevant considerations include the degree to which:

- foreign investors seek to invest equity in Australian firms, augmenting domestically-sourced investment;
- Australian firms seek to raise capital for their Australian investments on overseas capital markets, to supplement capital raisings in Australia; and
- there is arbitrage between Australia's financial markets and those overseas.

153. These different strands reflect the extent to which foreign investors participate within the Australian domestic capital market.

154. At the outset, the Authority notes that where a particular finance market boundary is adopted, then it is desirable that the same boundary be applied across the full rate of return calculation, so as to ensure internal consistency. For example, the practice to date has been to estimate efficient finance costs for the Australian domestic capital market. Under the Authority's recent approaches to estimating the rate of return, observations of finance market outcomes have had bearing on:

- for the cost of equity:
  - the expected market risk premium;
  - the equity beta;
- for the cost of debt:
  - the nominal risk free rate;
  - the expected debt risk premium; and
- the assumed utilisation of imputation credits (gamma).

155. To the extent that the boundary was expanded to encompass international data, then these estimates would need to be based on the wider data set.

Markets for equity

156. In evaluating the cost of equity, the practice of Australian regulators to date has been to adopt a domestic Capital Asset Pricing Model (**CAPM**). In the process, regulators have recognised the influence of foreign investors, where they invest domestically and thus contribute to market outcomes within Australia. So for example, estimates of the assumed utilisation of imputation credits have taken account of the estimated participation of foreign investors in Australian equity markets, consistent with Officer's framework.[60]

[60] As noted by the AER, the Officer WACC framework assumes 'full segmentation', whereby (see Australian Energy Regulator 2009, *Explanatory Statement: Electricity transmission and distribution network service providers: Review of the weighted average cost of capital (WACC) parameters*, www.aer.gov.au, p. 52):

> The assumptions underpinning the use of a fully segmented (domestic) CAPM is that the domestic capital markets completely segregated from international capital markets, and therefore domestic investors hold a combination of the domestic risk free rate and domestic market portfolio. Under this framework, only domestic systematic risk is priced for determining the WACC and the appropriate measure of an asset's non-diversifiable risk is the beta of the asset to the domestic portfolio. In contrast, the fully integrated (international) CAPM assumes that global capital markets are fully integrated, and that therefore investors hold a fully diversified global portfolio of assets. Under this approach, the non-diversifiable risk is the beta of the asset to the global market portfolio and the appropriate market risk premium and risk free rate will be that which is relevant to the global market portfolio.

157. On this basis, regulators have been satisfied that a Sharpe Lintner CAPM, based on domestic data, has met the requirements of the NGL and NGR. For these reasons, Australian regulators have not accounted for equity models that are based on international data.

Markets for debt

158. With regard to the cost of debt, the Authority recognises that regulated Australian firms raise debt both domestically and overseas. More than 70 per cent of Australian utility fixed coupon bonds outstanding at March 2013 were denominated in foreign currencies, while around 10 per cent of floating rate bonds were issued in overseas markets.[61]

159. The Brattle Group has suggested in the context of estimating the cost of debt that:[62]

> ...lack of data can be a serious problem in environments such as Australia, where there are limited numbers of rate regulated entities and few, if any, entities with the same risk characteristics as the target. Therefore, looking to other sources overseas, recent debt issuances or investment banks' forecasts of financing costs becomes important.

160. The Authority notes, however, that Australian markets for debt are closely linked to international markets, reflecting the policy of unrestricted capital mobility. With arbitrage, the cost of debt in Australia is similar to that in other developed countries, once all risk factors, including exchange rate risk, are taken into account.[63]

Evaluation

161. The Authority has given consideration to expanding the boundaries of the data set used for efficient financing costs – from just incorporating data from the Australian capital market – to account for outcomes in other overseas markets. Such a change would recognise that Australian firms are exposed to global financial markets, and that it is efficient for Australian firms to take account of the global costs of capital.

162. In weighing up the costs and benefits, the Authority has considered the following factors:

- availability and tractability of data:
  - expansion to account for international markets would enhance the sample size for many estimates;

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[61] The Authority in April 2013 examined all bonds issued by Australian utilities for the period from 1996 to 2013. A sample of 123 bonds was collected. Data was provided by Bloomberg.

In this sample, 92 bonds were fixed coupon bonds, 29 bonds were floating with the remaining 2 being other instrument types. Of the 92 fixed rate bonds, only 25 bonds were denominated in Australian dollars. Of the 29 floating rate bonds, three were issued in the Euro and United States markets.

[62] DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, Att. 4 (Brattle Group 2013, *Estimating the Cost of Debt*), p. 2.

[63] For example, McBrady et al note (McBrady M.R., Mortal S. and Schill M.J. 2010, Do Firms Believe in Interest Rate Parity? *Review of Finance* 14 (4), p. 695):

> Interest rate parity is a bedrock assumption of international finance. It asserts that debt yields are equivalent across currencies when considering expected movements in exchange rate spot rates (uncovered parity) or prevailing forward exchange rates (covered parity). Given its importance to international finance, the academic literature on interest rate parity is justifiably vast.

  - however, there would be a question as to how to select and evaluate what would be very large data sets from international markets;
  - there would also be a need to consider whether the international firm from which observations are derived has similar risk as the benchmark firm in Australia;
  - expansion to account for international markets could increase the regulatory cost of estimation significantly;
- cost of equity:
  - it would be a major task to account for equity risk on a consistent basis;
    - for example, there would be a need to determine whether there are specific factors relating to country systematic risk that influence outcomes for the rate of return;
  - it may be difficult to incorporate Australian and international data together; yet without Australian data the estimates may not reflect the true costs of equity for Australian firms;
- cost of debt:
  - expansion to account for international markets would require that the Authority evaluate, for the Australian benchmark firm, the efficient proportions of debt from each market, whether sourced in Australia or overseas;
    - however such data may not be publicly available;
  - as Australian markets for debt are closely linked to international financial markets, it is unlikely that the cost of debt would differ markedly, once converted into Australian dollar terms;[64]
    - tax;
  - an expansion to international markets would require account to be made of differing tax treatment, which could further add to the costs of the assessment.

163. The Authority considers that while an expansion of the boundaries to allow international data could have benefits, there would likely be significant costs, as well as potential for error. On balance therefore, the Authority remains of the view that it should continue to constrain the estimation boundaries to domestic financial markets.

164. Nevertheless, the Authority considers that international influences may still be taken into account, to the extent that this impact directly on Australian domiciled firms. There may also be occasions when it may be appropriate to consider only the impacts on the domestic investor. For example, the influence of the domestic tax regime on the international investor will be limited in some aspects.

165. In summary, the Authority's position is that the boundary should account for the full domestic data set, including any direct influences on the cost of capital for

[64] Otherwise there would be opportunity for arbitrage, as noted in the previous footnote. To the extent that differences remain, then these are likely to reflect differences in the circumstances of the Australian market as compared to the overseas markets.

Australian domiciled firms. This may include the influence of international investors in Australian markets for equity, or the influence of international lenders supplying debt finance directly to Australian firms.

166. These issues are considered in more detail in subsequent chapters, within the context of the evaluation of the cost of equity and the cost of debt. Those chapters set out approaches that deliver estimates of the return on equity and the return on debt, based on domestic data, which meet the requirements of the rules and perform best against the criteria. On this basis, the Authority considers that domestic markets best meet the requirements of the rules.

4.1.3 Conclusion

167. Financial markets will provide the observations required to evaluate the efficient financing costs of the benchmark efficient entity.

168. There are a range costs and benefits to be evaluated when considering whether to adopt a domestic or international form of any particular model of the rate of return or its components. On balance, the Authority considers that there would likely be significant net costs with moving to an international approach. Therefore, the Authority is of the view that it should continue to constrain the estimation boundaries for the rate of return to domestic financial markets.

169. The requirement for internal consistency means that a single definition of the finance market is relevant. The Authority considers that it is desirable that all parameters of the rate of return be estimated based on the Australian domestic market.

4.2 Benchmark efficient entity

170. It is a requirement that the benchmark efficient entity have efficient financing costs. As noted in the Consultation Paper, it is expected that the benchmark efficient entity would achieve this by structuring its finances so as to minimise its cost of capital, given the degree of risk applying in respect of the provision of the reference services. This requirement reflects the NGR and the allowed rate of return objective, and seeks to ensure that customers do not bear the costs of inefficient financing decisions by service providers.

171. Australian regulators have to date used the concept of the benchmark efficient entity when estimating the gearing ratio, the credit rating and the equity beta.

4.2.1 Submissions

172. Stakeholders generally accepted the requirement to define the benchmark efficient entity and to establish parameters based on that definition. The ENA for example supported the notion of a conceptual definition for the benchmark efficient entity, which is then parameterised through observations based on a sample of 'comparator' firms:[65]

[65] Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.com.au, Attachment, p. 4.

> ...it is helpful to approach the identification of benchmark characteristics as a two-step decision making process with a conceptual benchmark entity being established separately from the exercise of seeking to implement that in practice.

173. Stakeholders also considered that the implementation of the benchmark efficient entity needed to account for the circumstances associated with the provision of the particular reference services and the specific risks involved.

174. APIA for example submitted that the benchmark efficient entity cannot be applied in a 'one size fits all' manner.[66] APIA highlighted differences between gas and electricity service providers in terms of the diversity of the source of the gas upstream, the downstream characteristics of usage, and the form of the carriage model, concluding that the rate of return cannot be determined from some abstract conceptual entity with generic risks.[67]

175. DBP concurred, stating that:[68]

> ...it may well be the case that the "efficient financing costs" for one service provider are not the same as those of another service provider if the risks each service provider faces in the provision of reference services are dissimilar in degree. It may also well be the case that the "efficient financing costs" of all service providers are not the "lowest" costs because the benchmark efficient entity with a similar degree of risk as that which applies to each service provider does not enable the "lowest cost" of capital to be used.

176. GGT suggested that the regulator would need to take account of the degree of any differences in the risk characteristics of the benchmark entity and the service provider:[69]

> ... the more generic the benchmark efficient entity used by the regulator, the more critical it will be for the regulator to adjust its findings for the risks of the business to achieve a benchmark *with a similar degree of risk which applies to the service provider*.

177. ATCO suggest that the number of Australian entities with a degree of risk similar to that which applies to the service provider in the provision of reference services, and for which information is independently available, may be quite small:[70]

> ...Electricity distribution entities, and electricity and gas transmission entities, are unlikely to be comparables for a gas distribution entity. In consequence, there may not be sufficient data available to make statistically significant estimates of the CAPM beta, to estimate a debt margin, or to determine the gearing.
>
> ...ATCO is of the view that establishing the benchmark efficient entity will require extending the set of potential comparable entities to include similar entities from other (international) jurisdictions.

178. However, the MEU questioned the utility of the concept of a single benchmark efficient entity:[71]

> The MEU considers there is no such entity. Structures of ownership, decisions on retained earnings, debt and equity ratios, sources and terms of debt, etc are so wide reaching that a simplistic formula cannot identify what is the most efficient way of

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66 Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Attachment, p. 30.

67 The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, p. 31.

68 DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, p. 9.

69 Goldfields Gas Transmission 2013, *Submission ot the Economic Regulation Authority Consultation Paper: Guidelines for the Rate of Return for Gas Transmission and Distribution Networks*, www.erawa.com.au, p. 11.

70 ATCO Gas Australia 2013, *Response to Authority consultation paper on rate of return guidelines*, www.erawa.com.au, Section 4.5, p. 36.

71 Major Energy Users 2013, *Submission*, www.erawa.com.au, p. 13.

> combining all of these variables into one "benchmark efficient entity" and in fact different combinations could well be equally or more efficient.
>
> There is an assumption that debt and equity can be combined in such a way that allows a single "best practice" approach to setting a rate of return on assets. This is indeed a tall order, as debt and equity have quite differing characteristics and risk profiles. It is only by separating the two can the overall benchmark efficient funding be identified – by examining the fundamentals of sourcing both debt and equity in isolation.

179. The MEU also considered that a distinction should be made between private and public ownership, and that consumers should benefit from lower financing costs in the case of public ownership.[72]

4.2.2 Considerations of the Authority

180. In practical terms, there is a need to quantify the key characteristics of the benchmark efficient entity. Generally, this involves establishing a conceptual definition for the benchmark efficient entity, and then gathering evidence from real actual 'comparator' entities which resemble the conceptual entity, as a means to inform the benchmark parameters for the cost of equity and the cost of debt.

4.2.2.1 Conceptual issues

181. The Authority notes that the efficient benchmark need not reflect the exact financial characteristics of the service provider. Instead, the benchmark efficient entity should reflect the most efficient financial means to deliver the reference services. This provides incentive for the firm to move towards efficient financing, or to improve on those outcomes, in terms of the risk/cost of capital trade-off.

182. Hence the task for the regulator is to establish the efficient financing practices that would be adopted for delivery of the reference services, which would take account of the degree of risk associated with that delivery.

183. Risk is a key consideration, as the NGL and the NGR recognise. The elements of risk that need to be accounted for in the definition of the benchmark efficient entity – for the specific gas infrastructure regulated by the Authority – are considered in the next section. Here we refer to the more general considerations associated with defining the benchmark efficient entity.

Defining risk

184. Under portfolio theory, the risk factors influencing the expected returns of a benchmark efficient entity can be separated into systematic risks and non-systematic risks. This is an important risk categorisation, which helps to inform those risks which need to be compensated in the rate of return and those which do not.

185. Systematic risk relates to factors exogenous to firms – often associated with prevailing economic conditions – which will have an impact on all firms, to a greater or lesser degree.[73] Regulators need to be concerned with systematic risk

[72] Major Energy Users 2013, *Submission*, www.erawa.com.au, p. 11.

[73] Under portfolio theory, the measure of systematic risk for a particular asset is its co-variance with the overall market portfolio. This reflects the portion of variance in the asset's returns that are explained by the variance of the overall market. For example, this covariance, as a proportion of the overall market variance, informs the beta of the firm in the CAPM.

in setting the rate of return, as this risk exposure is non-diversifiable and will influence the risk adjusted returns required by equity investors seeking to invest in the regulated firm.[74]

186. Non-systematic risk, or diversifiable risk, on the other hand, relates to risks that are specific to the firm itself, or to the firm as part of a broader industry segment, and which can be either wholly or partially offset by an investor through an appropriate diversified portfolio.

187. The key issue then in assessing risk is to identify whether a risk is systematic or non-systematic, and the degree to which it may be offset. Judgment is required. We classify the range of possible risks in the section below on 'Degree of risk associated with the provision of reference services'.

Conceptual definition of the benchmark efficient entity

188. ENA has the view that the following conceptual definition of the benchmark efficient entity should apply:[75]

> A 'pure-play' regulated electricity or gas network business operating within Australia without parental ownership providing the same scale and scope of standard control / reference services to the same customer base at the current time.

189. Each element of the ENA's proposed definition is considered in what follows.

190. First, the inclusion of the term 'pure play' works to exclude non-regulated activities where it is practical to do so. The Authority has no issue with this inclusion.

191. Second, the term 'regulated electricity or gas network business' is intended to account for the specific type of business activity being dealt with, and that the business activity is regulated. Again, the Authority has no issue, except trivially, the Authority's Guidelines relate to gas, so the term electricity would be omitted.

192. Third, 'operating in Australia' is intended to account for country specific factors such as the currency, the level of economic growth and laws affecting business. The Authority considers that this is consistent with its intention to base the rate of return on data from domestic financial markets, so has no issue with this term.

193. Fourth, the element 'without parental ownership' is intended to recognise that some risks associated with the provision reference service cannot be eliminated, and thus must be compensated. In this event, 'without parental ownership' requires explicit recognition of those risks, to ensure that these are not simply transferred to the parent, in a way that is not accounted. However, the Authority notes that this relates only to risks that are systematic, and therefore which are not diversifiable. Risks that are diversifiable may be offset by an investor holding an appropriate portfolio. That investor may be either the parent or an independent investor. That said, the Authority accepts that *systematic* risks need to be accounted for at the entity level, and so accepts this clause.

[74] Some non-diversifiable risks may be managed by the firm itself, for example through purchase of insurance. Such expenditure would be explicitly recognised in operational expenditures, and hence in the cash flow of the regulated firm. Risks managed in this way would not need to be compensated through the rate of return.

[75] Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.com.au, Attachment, p. 15.

194. Fifth, the element 'providing the same scale and scope of standard control/reference services to the same customer base' is intended to recognise specific differences in the risk profile of the reference services. However, the Authority does not accept that differences in scale and scope necessarily lead to material differences in overall systematic risk.[76]

195. The Authority therefore does not accept the ENA's definition in this regard. The Authority considers that this part of the definition should align closely with the text of the allowed rate of return objective, namely 'with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services'.

196. Finally, the term 'at the current time' is intended to reflect prevailing market conditions and to recognise that characteristics of the reference services may change over time. These are reasonable considerations. However, the Authority considers the clause restrictive in this context, and also redundant. It is restrictive because the definition of the benchmark efficient entity should apply over the whole time of the access arrangement. It is redundant, because the benchmark efficient entity is the reference point for the determination of the rate of return for the regulatory years of the access arrangement, as per the allowed rate of return objective and the other clauses of NGR 87. The Authority therefore considers that this term should therefore be omitted.

197. Combining these elements, the Authority considers that the benchmark efficient entity should be defined as:

> A 'pure-play' regulated gas network business operating within Australia without parental ownership, with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services.

4.2.2.2 Implementation issues

198. The efficient finance practices of the benchmark should reflect the actual practices of comparator firms operating in the market with efficient financing costs.[77]

199. In its most recent decisions, for example, the Authority has based its estimates of efficient financing costs on benchmark results from the average of a sample of comparator firms, for:

- gearing;
- the equity beta;
- the credit rating – and the associated debt risk premium;
- the assumed utilisation of imputation credits (gamma).

[76] The Authority notes in this context that there is potential that other entities – for example involved in the provision of other types of infrastructure or even other types of goods or services in the economy more broadly – to have 'a similar degree of risk' as the benchmark efficient entity. For example, that there may be particular types of risk – for example relating to a specific level of credit risk – where a range of firms in the economy might be judged to have the same level of risk as the service provider in delivering the reference services.

Furthermore, comparisons based on similar entities outside of regulated infrastructure can be beneficial in breaking the circularity issues that can result from comparing one regulated entity with another. Circularity arises where observations of the market's valuation for the comparator are strongly influenced by a regulator's decision.

[77] This approach draws on the regulatory literature relating to yardstick competition, whereby the prices of the regulated firm are based on the costs of an average of other similar firms.

200. It is desirable that the benchmark not be hypothetical. This means that the benchmark must, as far as possible, reflect *achievable* financing practices, which reflect the practices of efficient firms exposed to a similar degree of risk as the regulated firm. Importantly, by reflecting achievable efficient financing practices, the benchmark will allow the service provider 'reasonable opportunity' to achieve the efficient parameters determined for the benchmark entity.[78]

Interpretation of the term 'similar'

201. The requirement in the allowed rate of return objective is for the benchmark efficient entity to have a 'similar degree' of risk as that of the service provider providing the reference services. The term similar recognises the practicalities of approximating risk profiles. Provided that there is not a material difference between that of the benchmark efficient entity and that associated with providing the reference services, then the allowed rate of return objective will be met.

202. The process of developing benchmark estimates therefore involves observing the efficient financing practices of a set of businesses which are 'similar' comparators for the benchmark.

203. Here the key consideration is the meaning of the term 'similar'. Specifically, how wide is the range of allowed differences in the risks, while still being considered similar? Increasing the range would account for the inherent uncertainties in estimating risks. Increasing the range would also allow the sample sizes to be increased, improving the quality of the estimates. However, increasing the sample through allowing greater risk differentials implies some increased probability that the risk profile of the service provider may have a difference to the risk profile of the relevant benchmark entity. There is a trade off in terms of precision and material difference.

204. The Authority recognises that uncertainty in estimation approaches, particularly when it comes to risk assessments, mean that it should not fall into the trap of 'misplaced precision'. The AEMC, for example, suggested:[79]

> ...the Commission recognises that if a regulator concluded that the risk characteristics of a benchmark efficient service provider are different between, for instance, electricity and gas service providers, there may be challenges in all cases in identifying sufficiently precise measurements of the quantum of the difference for determining the rate of return.

205. The Authority therefore agrees with the AER, which has noted that larger samples are desirable, unless this would lead to a clear material bias in the efficient financing costs:[80]

> A preference for large samples over close matches to the benchmark—this principle would suggest that all data should be included in the sample unless there was a very clear reason to expect that it would bias the end estimate. Using larger samples can minimise the shortcomings of individual data sources or data points. However, this needs to be weighed against the risk of using a large sample of data that is not reflective of the benchmark efficient firm.

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[78] The requirement that the firm have 'reasonable opportunity to recover at least the efficient costs the service provider incurs in providing reference services' is a requirement of the Revenue and Pricing Principles in the

[79] Australian Energy Market Commission 2012, *Rule Determination National... Rule 2012,* www.aemc.gov.au, p. 67.

[80] Australian Energy Regulator 2012, *Rate of Return Guidelines Issues Paper*, www.aer.gov.au, p. 22.

Public or private ownership

206. The Authority does not consider that a distinction should be made between public or private ownership. It is important to recognise that the requirement for economic efficiency leads to the interpretation of efficient financing costs as defining the opportunity cost of capital. Efficiency requires that this be the same for all firms in the economy, once adjusted for risk.

207. Competitive neutrality principles that apply to state owned utilities reflect this view. State Treasuries are required to adjust the cost of debt to ensure that debt neutrality or government guarantee fees are incorporated in the yield.

208. Such adjustments recognise that without the passing of risk to the government parent, the state owned regulated firm would face the same cost of debt as a private sector regulated firm. This insight highlights that introducing a distinction between public and private ownership would violate the term ‘without parental ownership’.

A single benchmark or multiple benchmarks

209. The Authority recognises that the allowed rate of return requires that it account for risks associated with the provision of the reference services. This account may be made either through a single benchmark, which is then adjusted, or through developing multiple benchmarks that are specific to each of the reference services in question.

210. The Authority’s preference is to retain a single ‘average’ benchmark efficient entity for gas pipeline and network service provision in the Australian domestic market. Firms with similar risk characteristics, depending on the parameter in question, would inform the comparator sample. The average of these observations would provide the single benchmark efficient entity financing costs for the provision of gas pipeline and network services in Australia.

4.2.3 Conclusion

211. The benchmark efficient entity is defined as:

> A ‘pure-play’ regulated gas network business operating within Australia without parental ownership, with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services.

212. The finance practices of the benchmark efficient entity should reflect the actual practices of firms operating in the market which exhibit efficient financing costs. The Authority will base its estimates of efficient financing costs on the results from an average of a sample of comparator firms with efficient financing costs that are judged to be ‘similar’ to the single benchmark efficient entity for the provision of gas pipeline and network services in Australia.

213. The Authority will use its judgment to weigh up whether it needs to adjust the parameters, the return on equity, the return on debt, or the overall rate of return for the single benchmark efficient entity, in order to account for any relative risk differential between it and the risks involved in the provision of the reference service in question.

214. In doing so, the Authority would weigh up and account for the relative differences in the various risks in the sample of comparators and in the provision of the reference services.

4.3 Degree of risk associated with provision of reference services

215. As noted above, the perceived degree of risk associated with the service provider in providing reference services is a key element in the cost of capital. The risks that matter for the investor, and hence for the rate of return, are the systematic risks.

4.3.1 Submissions

216. In terms of assessing risks, submissions recognised the need to identify risks and to classify these. APIA, for example, suggests the following process to determine risk levels for service providers:[81]

1. Define the risks for a service provider.
2. Identify whether they are systematic or non-systematic.
3. Examine the risks of the peers of the service provider.
4. Assess the relevance of the risk for benchmarking.

217. In this context, APIA identified a number of relevant considerations for risk, such as:[82]

> ...the reliability of gas suppliers, the location of the assets, the conditions in which they are operated and maintained, the state and efficiency of capital markets, the credit-worthiness of contractual counterparties and so on.

218. APIA considers that these risk differences create materially different risk profiles both among gas utilities, and as compared to electricity supply infrastructure.

219. DBP considers that an analysis of the degree of risk involved in the provision of reference services will require:[83]

> ...either an assessment by the Authority of the differences in risks between each reference service that is provided by each service provider, or the identification by the Authority of particular types of risks which it will take into account when determining a service provider's rate of return. The detail as to whether an individual service provider is subject to particular risks, and how such risks will be accounted for, should be left to specific access arrangement determinations.

4.3.2 Considerations of the Authority

220. As noted above, the Authority considers that it is reasonable to consider risk in terms of whether it is systematic, and hence exogenous, or non-systematic and therefore diversifiable. The regulator needs to account for systematic risks.

221. The ENA appeared to support this approach, when it stated: [84]

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[81] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, p. 31.

[82] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, p. 29.

[83] DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, p. 13.

> ...the benchmark should provide incentives for the network service provider to control the risks that it can control optimally while removing from the network business the impact of undiversifiable risks that it cannot control.

222. The Authority therefore considers that a first step is to identify the range of potential risks, and a second to classify whether those risks are potentially systematic or non-systematic.

223. A further step is to then assess whether the identified systematic risk is material to the investor, and whether the risk needs to be accounted for in the rate of return. The perspective of the investor is important, as the rate of return is the compensation required to induce the investor to supply capital to the firm.

4.3.2.1 Identifying and classifying risk

224. The key risks may be grouped as:

- revenue risk under the price cap regime applying to gas pipelines and networks;
- input price risks;
- financial risks; and
- political/regulatory risk;

Revenue risk

225. A range of risks may contribute to potential variability in revenue, due to variability in pipeline or network throughput. These risks include:

- upstream supply risk – reflecting the potential for the pipeline or network to become stranded;
- operating risk – reflecting the potential for operational or technical problems to reduce throughput for a period of time;
- competitive risk – reflecting the potential for competitive bypass or competing technologies or energy services to reduce demand for the pipeline or network services;
- downstream demand risk – reflecting the composition of demand and its diversification.

226. Upstream supply risk will be unique to the particular pipeline or network. Some elements of supply risk will be within the control of the entity itself, for example related to decisions on the size of the pipeline or network. In this case, shareholders should bear the risk. Additionally, an investor may diversify across pipelines to reduce the risk of adverse supply shocks. As a consequence, upstream supply risk in general should not be compensated through the rate of return

227. Operating risks also are within the control of the entity. Operational risk may be reduced or eliminated through appropriate expenditure on capital equipment and maintenance. Operating risks in general should not be compensated through the rate of return.

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[84] Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.com.au, Attachment, p. 15.

228. Competitive risks will be unique to the entity, but the risk should be able to be diversified by the investor through holding a portfolio of assets. For example, to the extent that the demand for gas from a transmission pipeline is reduced by a innovative new technology, say solar power, then the investor may invest in the solar power industry. Similarly, to the extent that competitive bypass is possible, then the investor could invest in the bypass itself, or in the industries that would benefit from the bypass. On this basis, competitive risk in general should not be compensated through the rate of return.

229. Downstream demand risk has the potential to be outside the control of the firm, and therefore exogenous and systematic. Indeed, there will be a part of the volatility in revenue which does reflect systematic demand risk faced by all firms in the economy. Such demand risk will be reflected in the variability of returns on equity, which is captured through models such as the Capital Asset Pricing Model. Such variability will also influence the risk of default of the business, among other things, which is discussed below.

230. However, some proportion of the demand risk may be diversifiable. An example might be a gas transmission pipeline, which is heavily exposed to a small set of commodity prices. The risk faced by this pipeline is for a significant demand decline if commodity prices fall, and downstream customers fail. However, this risk may be diversifiable to an extent by the investor. To continue the example, a non-systematic downturn in commodity prices, say reflecting a large increase in supply capacity somewhere in the world, may be offset by higher returns in other sectors of the economy, as businesses that use the commodity as an input experience lower cost structures.

231. In general, to the extent that revenue risk is diversifiable, it should not be compensated in the rate of return. Systematic revenue risk will relate to the demand conditions in the economy, which are captured by models of the return on equity.

Input price risks

232. The key risks may be grouped as:

- input cost increases – whether due to industry, regional, or international cost increases, including those arising from exchange rate risks;
  - these may affect operating costs and investment costs; and
- inflation risks – which may drive input costs up at a more rapid rate than prices and hence revenue.

233. Industry or regional input cost risks should be diversifiable by investing in other industries or other regions. That is, to the extent that input costs to an industry or region are rising, then input costs to other industries or regions should fall.

234. With regard to inflation, it is noted that input costs for the regulated are part of the building block, and will include inflation. To the extent that there are changes in the composition of inflation, affecting input costs differentially, then these should be diversifiable, as it is likely that the impact on returns of differential rises in input cost rises for the entity could be offset by investing in domestic industries that faced slower input cost rises.

235. These risks therefore in general should not be compensated through the rate of return.

Financial risks

236. The key risks may be grouped as:

- refinancing risks;
- interest rate mismatch risks;
- liquidity risks;
- default risks.

237. Re-financing risk relates to the potential that the firm will not be able to roll over its debt when its existing facilities end. Firms tend to manage this risk by reducing the amount of debt that needs to be re-financed at any point in time by diversifying the sources of debt, and 'staggering' the timing of debt issuances. This gives a portfolio of debt comprising different instruments with different terms to maturity, which allows the firm to reduce these risks. The investor may also further reduce this risk by diversifying across firms. Nevertheless, some level of re-financing risk will remain, related to general economic conditions, which will need to be compensated. Typically, this risk is captured in the debt risk premium that is applied to the regulated firm.

238. Interest rate mismatch risks, or equivalently, interest rate re-pricing risks, refer to the potential that the firm, when it re-finances, faces interest rates that diverge from those underpinning its pricing, and hence revenue. All firms will face this risk, to a greater or less degree (see chapter 6 and appendix 4). Firms may manage these mismatch risks by hedging, which will may reduce the degree of mismatch.

239. Liquidity risks refer to the ability or otherwise to trade an asset at any particular point in time. The less liquid an asset, the more risky, and the higher rate of return that is likely to be required to hold that asset. This liquidity premium required by the investor in the regulated firm will be influenced by the liquidity in markets more generally. As a result, there is a systematic component in liquidity risk.

240. Default risk will be influenced by:

- the capacity to generate cash flows from operations;
- the volatility in those cash flows;
- debt coverage – given by the ratio of cash flows to interest and principal payments.

241. Default risks arise from the potential of the firm to run into cash flow difficulties, such that it is unable to meet its financial obligations and becomes insolvent. All firms have some element of this risk. Default risks are reduced where cash flows are stable and provide good coverage of expenses. Credit ratings agencies assess the potential for individual firm's default risk based on a range of indicators, including the appropriateness of the firm's level of gearing. Other considerations can relate to the operating environment, including sovereign and

regulatory risk, as well as the scale and complexity of operations.[85] These credit ratings are a key component informing the debt risk premium required by lenders.

242. All firms face these financial risks to a greater or lesser degree. A significant component of these risks will be influenced by general market conditions, and hence are systematic. The systematic components will need to be compensated through the rate of return.

Political/regulatory risk

243. The key risks may be grouped as:

- policy changes that may affect input costs;
- regulatory framework changes, which for example may affect prices and revenue.

244. All firms in the economy face the risk of policy change. For example, a change in corporate taxation rates would be reflected in input costs, as well as in the after-tax profitability. As such, this is systematic risk. Such systematic risk needs to be compensated. However, it is possible that such risk could be transmitted through interest rate risk and the other financial risk elements, as it is faced by all firms in the economy.

245. The utility regulatory framework can have an impact on the risks perceived by the investor. For example, the effectiveness of governance arrangements and the associated quality of utility regulation, as well as checks and balances on the regulator itself through provision for appeal of regulatory decisions, will have a bearing on perceptions of the continued 'reasonableness' of regulated returns.

246. However, such risks will be one of a range of regulatory requirements placed on the firm. The utility will also face a raft of other regulation and policy constraints, for example relating to human resources or environmental practice, which will be common with those constraints for other firms operating elsewhere in the economy.

247. Other elements of the utility regulatory framework may manifest elsewhere in the risk matrix. For example, the type of regulatory control – whether revenue cap or price cap – may influence the extent of demand risk for the regulated firm.

248. Overall, the potential for future changes in the regulatory framework will introduce risk for the investor. Such risks may be mitigated by good regulatory governance, for example ensuring that adequate notice is provided of change. In addition, provision for transitional arrangements where appropriate may also help to increase certainty and reduce the compensation required for these risks.

[85] The size of the entity may influence the scale and complexity of operations, as well as liquidity or the ability to engage effectively with financial markets. However, as observed by Frontier Economics in its Discussion Paper for the AER, 'even if the cost of capital is related negatively to business size, there is no compelling extant theory that explains such a relationship. This makes it difficult to judge to what extent the relationship is applicable to specific sectors, such as regulated utilities' (Frontier Economics 2013, *Assessing risk when determining the appropriate rate of return for regulated energy networks in Australia: A discussion paper prepared for the AER*, provided as part of workshop materials, p. 30). Where a smaller operation involves increased costs of engaging with financial markets, then these can be addressed in operating costs, rather than through the rate of return.

249. A significant proportion of regulatory risk will be diversifiable by the investor. This is because any change which increases (decreases) the relative profit of the regulated firm will tend to flow through to the prices of the reference services, decreasing (increasing) costs to other firms, and hence providing offsetting changes in returns. As a result, regulatory risk is likely to be a reasonably small consideration in the investor's requirement for the rate of return. Such risk is likely to be picked up as part of the broader sovereign risk, as it will reflect investor's perceptions of the general standards of policy and government.

4.3.2.2 Accounting for risk

250. As noted above, the Authority intends to use its judgment to weigh up whether it needs to adjust estimates of the parameters, the return on equity, the return on debt, or the overall rate of return, determined for the benchmark efficient entity, in order to account for the degree of risk of the regulated entity. Such an adjustment would be required to account for any relative risk difference between the 'average' set of risks faced by the benchmark efficient entity, and the specific risks involved in the provision of the reference services in question.

251. In making its adjustment, the Authority would weigh up and account for differences in the various risks faced by the sample of comparators, and by the regulated entity in providing the reference services. As noted above, an adjustment would be more likely where there was a material difference in risk, such that the risks could not be described as being 'similar'. The set of risks outlined above would provide the framework for this evaluation.

252. The Authority considers that the key risks it will need to consider in this evaluation will be those which have the potential to introduce significant differences in the exposure to systematic risk. In particular, in the context of gas pipelines and networks, it is likely that these differential risks relate principally to downstream demand risk. This would recognise that some gas pipelines are more exposed to the business cycle through commodity prices than other energy networks.

4.3.3 Conclusion

253. The Authority will use its judgment to determine whether it needs to adjust the parameters, the return on equity, the return on debt, or the overall rate of return, in order to account for any material difference in risks faced by the ('average') benchmark efficient entity as compared to the regulated entity providing the reference services.

254. The Authority considers that the key risks it will need to consider in this evaluation will be those which have the potential to introduce material differences in the exposure to systematic risk. The Authority considers that, in the context of gas pipelines and networks, it is likely that these differential risks would relate principally to downstream demand risk. This would recognise that some gas pipelines are more exposed to the business cycle through commodity prices than other energy networks.

4.4 Draft Guideline

255. The allowed rate of return objective is set out at NGR 87(3):[86]

> 87(3) The *allowed rate of return objective* is that the rate of return for a service provider is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services (the *allowed rate of return objective*).

256. The wording of the allowed rate of return objective requires that the rate of return is to be based on the:

- efficient financing costs; of
- a benchmark efficient entity; with
- a similar degree of risk as the service provider in respect of the provision of reference services.

257. The Authority's approach to each of these elements is defined in what follows.

4.4.1 *Efficient financing costs*

258. Financial markets will provide the observations required to evaluate the efficient financing costs of the benchmark efficient entity.

259. The Authority will constrain the estimation boundaries for the rate of return to domestic financial markets.

260. The requirement for internal consistency means that a single definition of the finance market is relevant. The Authority considers that it is desirable that all parameters of the rate of return be estimated based on the Australian domestic market.

4.4.2 *The benchmark efficient entity*

261. The benchmark efficient entity is defined as:

> A 'pure-play' regulated gas network business operating within Australia without parental ownership, with a similar degree of risk as that which applies to the service provider in respect of the provision of reference services.

262. The Authority will base its estimates of efficient financing costs on the results from an average of a sample of comparator firms with efficient financing costs that are judged to be 'similar' to a single benchmark efficient entity for the provision of gas pipeline and network services in Australia.

4.4.3 *Accounting for risk*

263. The Authority will use its judgment to determine whether it needs to adjust the parameters, the return on equity, the return on debt, or the overall rate of return, in order to account for any material difference in risks faced by the ('average') benchmark efficient entity as compared to the regulated entity providing the reference services.

[86] Australian Energy Market Commission 2012, *National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012 No. 3,* www.aemc.gov.au, 87(3).

264. The Authority considers that the key risks it will need to consider in this evaluation will be those which have the potential to introduce material differences in the exposure to systematic risk. The Authority considers that, in the context of gas pipelines and networks, it is likely that these differential risks would relate principally to downstream demand risk. This would recognise that some gas pipelines are more exposed to the business cycle through commodity prices than other energy networks.

5 Gearing

265. Gearing refers to the proportions of a regulated business assumed to be financed by debt and equity. Gearing is defined as the ratio of the value of debt to total capital (i.e. including debt and equity), and is used to weight the costs of debt and equity when the regulated weighted average cost of capital (**WACC**) is determined. The relative proportions of debt and equity that a firm has outstanding constitute its capital structure. The capital structure choices differ across industries, as well as for different companies within the same industry.

266. Assuming a perfect capital market,[87] the value of the firm does not depend on its capital structure. As a consequence, increasing the leverage of a firm's capital structure will not increase the total value of the firm. In their seminal paper on capital structure, Modigliani and Miller (1958)[88] argued that an increase in leverage acts to change the allocation of the cash flows between debt and equity holders. They concluded that "*In a perfect capital market, the total value of a firm is equal to the market value of the free cash flows generated by its assets and is not affected by its choice of capital structure.".* This is known as *MM proposition I.*[89]

267. When the assumption of a perfect capital market is relaxed to remove the assumption of no taxation, increasing leverage can result in an increase in value to the firm. This increase in value arises because interest payments are costs to the firm and attract a tax deduction. The value generated by this mechanism is known as the interest tax shield, which refers to the reduction in taxes paid due to the tax deductibility of interest payments. As a consequence, *MM proposition I* can be modified to included taxation. A new proposition arises that *"The total value of the levered firm exceeds the value of the firm without leverage due to the present value of the tax savings from debt,* $V^L = V^U + PV(InterestTaxShield)$*",* which is known as *MM proposition II.* [90] [91]

268. This modified MM proposition suggests that it is optimal for firms to have a 100 per cent gearing level, given the value generated by the interest tax shield. However, in reality, a firm that has difficulty meeting its interest payments will be in financial distress and as a consequence, will face significant costs. As such, a firm cannot maximise its value through leverage as it will be constrained by the possible financial distress costs associated with an increase in leverage. Therefore a trade-off exists between the interest tax shield associated with debt and the increase in possible financial distress costs. Trade- off theory asserts that the value of a geared firm is equal to its value without leverage, plus the present value of the interest tax shield minus the present value of financial distress costs which can be expressed as follows:[92]

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87 Perfect capital markets assume that securities are fairly priced, there are no tax or transaction costs and cash flows arising from a firms activities are not influenced by their financing choices.

88 Modigliani, F. and Miller, M. "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review* (1958).

89 Berk, J.; DeMarzo, P.; and Harford, J. 2008, *Fundamentals of Corporate Finance*, Pearson International, p. 489.

90 *where* V^L *is the levered value of the firm,* V^U *is the unlevered value of the firm.*

91 Berk, J.; DeMarzo, P.; and Harford, J. 2008, *Fundamentals of Corporate Finance*, Pearson International, p. 499.

92 Ibid, p. 504.

$$V^L = V^U + PV(InterestTaxShield) - PV(FinancialDistressCosts)$$

(3)

269. Another theory on capital structure, known as the *Pecking order theory*, relates the adverse selection problem to the capital structure of a firm. Pecking order theory asserts that investors will demand a discount on equity and debt issuance due to the lack of information they posses relative to managers of the firm. As such, managers will avoid selling equity if they have to discount it to find buyers. The adverse selection problem extends to debt issuance but to a lesser extent than equity, as equity holders have residual claim to the assets of a firm and as such, equity is considered a more risky asset. As a consequence, in order for a firm to fund its operations, pecking order theory states that mangers will prefer to use retained earnings, followed by debt and finally choose to issue equity only if needed.[93]

270. Consequently, based on various theories on the capital structure of a firm, the benchmark gearing ratio is considered to be the capital structure of a benchmark efficient utility business.

271. In addition to being used to weight the expected returns on debt and equity to determine the regulated rate of return, the level of gearing of a benchmark efficient business may also be used: (i) to re-lever asset betas for the purposes of analysing the level of systematic risk across businesses in the estimate of equity beta; and (ii) as a factor in determining an appropriate credit rating for deriving the debt risk premium (**DRP**).

272. A benchmark level of gearing is not directly observable. Current Australian regulatory practice indicates that the benchmark gearing of 60/40 (i.e. 60 per cent debt and 40 per cent equity) is derived from the average of actual gearing levels from a benchmark sample of comparable Australian firms.[94]

273. The Authority adopted benchmark gearing of 60/40 together with benchmark credit ratings of BBB/BBB+ in all three regulatory decisions for gas businesses in Western Australia.

274. Current Australian regulatory practices in relation to benchmark gearing are presented in Table 2 below.

93 Ibid, p.509.

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

Table 2 Benchmark gearing in the Australian regulatory decisions

Regulator	Year	Industry	Gearing [Debt/Total Asset]
ACCC[95]	2011	Fixed Line Services (Telecommunications)	40%
AER[96]	2012	Gas Distribution Network	60%
ERA[97]	2012	Electricity Distribution/Transmission	60%
ERA[98]	2011	Gas Transmission	60%
IPART[99]	2012	Water, sewerage, stormwater drainage and other services	60%
QCA[100]	2012	Water, sewerage, stormwater drainage and other services	60%
ESCOSA[101]	2012	Water, sewerage, stormwater drainage and other services	60%

Source: Compiled by the Economic Regulation Authority

5.1 Approaches for determining benchmark gearing

275. The Authority notes that various approaches are available for determining benchmark gearing. These approaches were previously examined by the AER in its 2009 WACC Review. Each of these approaches is discussed in turn below.

276. *First*, in its report to the AER in 2009 on the estimated value of equity beta, Associate Professor Henry from the University of Melbourne adopted the book value of net debt,[102] instead of using gross debt. As such, gearing is determined as:

95 Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 59.

96 Australian Energy Regulator, *Access Arrangement Information for the ACT, Queanbeyan and Palerang gas distribution network*, 1 July 2010 – 30 June 2015 p. 6.

97 Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

98 Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p. 158.

99 Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p. 197.

100 Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 498.

101 Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p. 49.

102 Net Debt is calculated as: Short-term borrowings plus long-term borrowings less Cash & Near Cash items less Marketable Securities less Collaterals. It is noted that in the banking, financial services, and insurance formats, marketable securities are not subtracted to arrive at Net Debt.

$$\overline{Gearing} = \frac{\overline{Net\ Debt}}{\overline{Net\ Debt} + \overline{MV\ Equity}} \tag{4}$$

where (**MV**) represents the market values and (**BV**) represents book values.

277. Second, Standard and Poor's (**S&P**) have reported gearing levels using the book value of debt and the book value of equity. The book value of equity has been reported by Bloomberg as the balance sheet value. S&P's gearing is determined as below.

$$\overline{Gearing} = \frac{\overline{BV\ Total\ Debt}}{\overline{BV\ Total\ Debt} + \overline{BV\ Equity}} \tag{5}$$

278. Third, the market values of debt and equity could be used in determining benchmark gearing. However, as debt is traded infrequently, it is difficult to obtain the market value. As such, the book value of debt is used as a proxy for its market values. This method is also known as the hybrid approach adopted by Bloomberg. The benchmark gearing level for a benchmark efficient entity is defined as follows.

$$\overline{Gearing} = \frac{\overline{BV\ Total\ Debt}}{\overline{BV\ Total\ Debt} + \overline{MV\ Equity}} \tag{6}$$

279. *Four*, the Allen Consulting Group (**ACG**) also proposed to the AER in the 2009 WACC Review that the hybrid approach utilised by Bloomberg should be adjusted for "double leveraging"[103] and stapled securities.[104] However, as an extensive search of Bloomberg has not provided data for these double leveraged and stapled securities, the Authority is of the view that this approach is not fit for purpose in the rate of return guidelines.

5.2 The Authority's estimates of benchmark gearing

280. In determining benchmark gearing for the purpose of this rate of return guidelines for gas businesses in Western Australia, the Authority considers that it is appropriate to consider all available approaches which can be used to derive an appropriate benchmark gearing level. However, as previously noted, the approach proposed by ACG has not been considered due to a lack of data.

281. For consistency between the Authority's estimate of equity beta and the benchmark credit rating, the Authority considers that the starting point is to form a benchmark sample from which the benchmark gearing level can be determined. The Authority is also of the view that companies included in the benchmark sample must satisfy three criteria. *First*, the company must be a network service provider in the gas and/or electricity industry in Australia. *Second*, the company must be listed so that the market value of its equity can be estimated using available data sources such as Bloomberg. *Third*, data on the values of debt and equity must be available.

[103] A parent holding company raises funds through debt and acquires equity shares in its subsidiaries using the dividends paid to finance interest repayments on the holding company's debt.

[104] Where two or more securities are bound together contractually and listed on an exchange so they cannot be traded separately.

282. The Authority considers that it is appropriate to utilise the list of Australian rated utilities published by S&P as a starting point. This is also utilised in the Authority's estimate of the benchmark credit rating.

283. The Authority notes that, for the period from 2008 to 2012, the following 6 companies have satisfied the above three criteria. A description of these companies in the benchmark sample is included in Appendix 5.

- APA Group

  (Gas Net Australia (Operations) Pty Ltd/APT Pipelines Ltd)
- Diversified Utility and Energy Trusts (DUET) Group
- Spark Infrastructure

  (The Citipower Trust/Powercor Australia, LLC)
- Hastings Diversified Utility Fund (now APA Group in 2013)

  (ElectraNet Pty Ltd)
- Envestra Ltd; and
- SP AusNet Group

284. The Authority notes that these companies were also included in the sample from which the equity beta is estimated in the Authority's recent study in 2013.

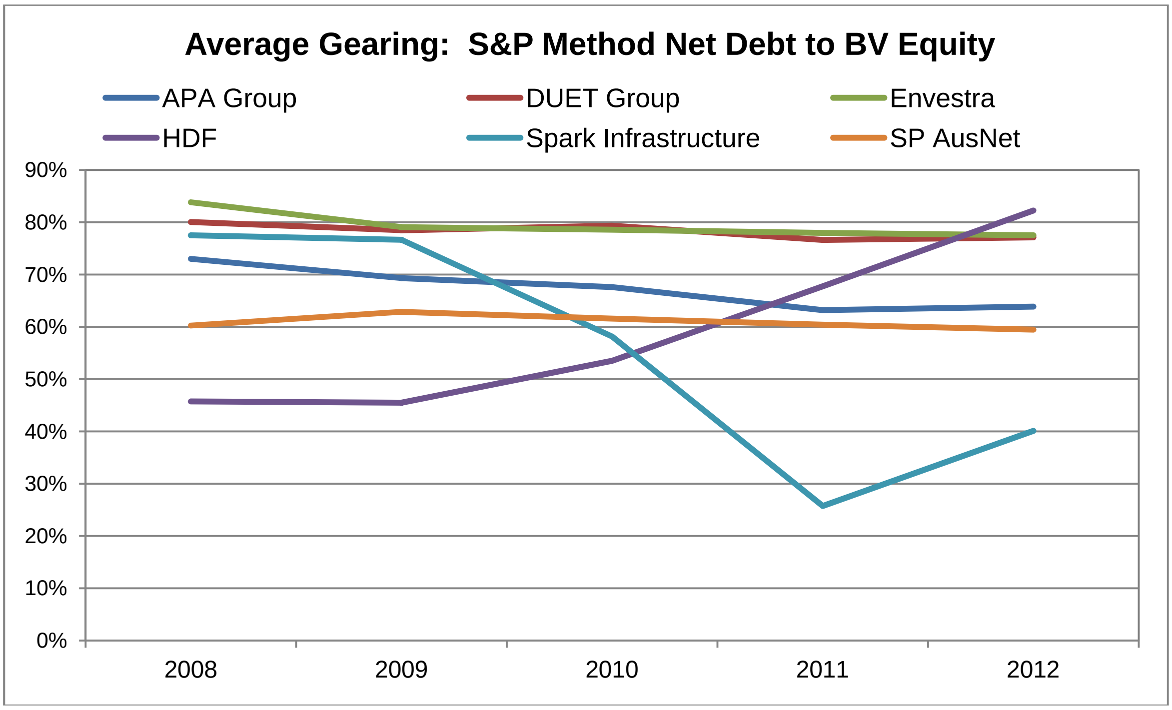
Table 3 The average gearing level across various methods, 2008 - 2012

Year	Henry (2009)'s Measure	Standard and Poor's Measure	Bloomberg's Hybrid Approach
2008	60%	70%	62%
2009	67%	69%	67%
2010	60%	66%	63%
2011	54%	62%	57%
2012	52%	65%	54%
Average	**58%**	**66%**	**61%**

Source: Data from Bloomberg and the Economic Regulation Authority's estimate

285. Table 3 presents that, over the 5-year period from 2008 to 2012, the average gearing level for the benchmark sample falls within a range of 58 per cent to 66 per cent depending on different approaches adopted. As a result, the Authority is of the view that a benchmark gearing level of 60 per cent is appropriate based on the benchmark sample over the last 5 year period. Benchmark gearing of 60 per cent debt has also been consistently adopted by the Authority and other Australian regulators in their previous regulatory decisions.

Figure 1 The gearing for each business in the benchmark sample under the S&P's measure, 2008 - 2012



Source: Bloomberg

286. Figure 1 indicates that gearing levels for each business in the benchmark sample can vary significantly across years. In addition, Figure 1 also shows that the gearing levels utilised in each business are significantly different from others businesses in the sample. DUET group and Envestra have been highly geared with an average gearing over the last 5-year period close to 80 per cent. SP Austnet and APA Group have been somewhat lower sitting around 65 per cent. Spark Infrastructure has dramatically moderated its gearing level from approximately 75 per cent in 2008 down to approximately 40 per cent in 2012. Conversely, Hasting Diversified Utility Fund (**HDF**) has rapidly increased its gearing from around 45 per cent to over 80 per cent prior to its takeover by APA Group. Generally the trend has been toward a decreased level of gearing.

5.3 Summary of submissions

287. In the Authority's Consultation Paper, *Guidelines for the Rate of Return for Gas Transmission and Distribution Networks,* published on 21 December 2012, the Authority sought submissions from stakeholders on the estimates and methodology for estimating a benchmark credit rating.

288. In its submission, ATCO Gas submitted determining the benchmark gearing level must be guided by rule 87 of the NGR.[105] ATCO submitted that as gearing represents the financial risk, the level of gearing should replicate that of the benchmark efficient firm. ATCO was of the view that they see no obvious alternative to benchmarking with respect to gearing. In addition, ATCO submitted that both the AER and the Authority have required, for over a decade, a gearing of 60:40 debt to equity be used in price determinations. As a consequence of this

[105] ATCO Gas Australia, "Response to ERA consultation paper on rate of return guidelines", 28 February 2013.

requirement, ATCO stated that regulated service providers have aligned their financial structures to be consistent with this assumption. As such, ATCO submitted it would not expect to see a rapid shift away from the assumed 60:40 gearing ratio.[106]

289. Wesfarmers Chemicals, Energy & Fertilisers submitted that the Authority should consider matching as closely as possible the gearing level of the comparator group used in the development of the benchmark gearing level.[107]

290. In its submission, DBP has made similar points to ATCO Gas. In addition, DBP argued that the benchmark gearing level should be guided by Rule 87, and not any criteria external to the regulatory regime of the NGR. As a consequence, DBP again submits that the Authority must assess the degree of risk the service provider faces. Specifically, it submits that the Authority must focus on the specific risks and not the generic risks a pipeline service provider is exposed to.

5.4 Considerations of the Authority

291. The Authority considers that the benchmark gearing level determined in this rate of return guidelines should match the gearing level derived from the benchmark sample including comparable firms with Australian regulated gas businesses as closely as possible. The Authority is of the view that Australian regulated businesses will move towards the benchmark gearing level in the long run.

292. The Authority agrees with ATCO's submission that the benchmark gearing of 60 per cent debt has been adopted by the Australian economic regulators for a long period of time. However, the Authority is of the view that the determined benchmark gearing may vary in response to prevailing conditions and practices adopted by comparable businesses with regulated firms.

293. The Authority is not convinced by DBP's submission that the Authority should focus on the specific risks and not the general risks a pipeline service provider is exposed to. The Authority is of the view that an efficient benchmark entity is considered when the regulated rate of return is determined. As such, specific risks for each regulated businesses will not be considered in isolation for the purpose of determining gearing. The issue of business specific risk is addressed in more detail in chapter 4.

5.4.1 Evaluation

294. The Authority is not aware of any new methods which can be used to determine a benchmark gearing level. The Authority is open to considering any new methods proposed.

5.4.1.1 Selection of approach

295. Current Australian regulatory practice indicates that an average gearing level determined from a benchmark sample of Australian utility businesses is the most relevant approach for the purpose. The AER came to the same conclusion in its 2009 WACC Review. The Authority is not aware of any new method which has

[106] ATCO Gas Australia, "Response to ERA consultation paper on rate of return guidelines", 28 February 2013.

[107] Wesfarmers Chemicals, Energy & Fertilisers, "Rate of Return Guidelines Review", 28 February 2013.

been proposed and considered by Australian regulators. As such, the Authority is of the view that the current approach, as illustrated in this chapter, is currently the most relevant approach.

5.4.1.2 *Selection of firms in the benchmark sample*

296. As previously discussed, the Authority considers that it is appropriate to include selected Australian companies subject to similar risk in the benchmark sample which is used to determine a benchmark credit rating. The selected companies must satisfy three criteria. *First*, the company must be a network service provider in the gas and/or electricity industry in Australia. *Second*, the company must be listed so that the market value of its equity can be estimated using available data sources such as Bloomberg. *Third*, data on the values of debt and equity must be available.

297. The Authority considers that there is no precedent in terms of how far historical data can be traced back. It is generally accepted historical data over a longer period may provide a better statistical estimate of the input WACC parameters. However, over a longer historical period there may have been structural breaks in the economy and as such, some data is no longer relevant to serve as a proxy for the present.

298. The Authority is of the view that, as long as there is sufficient data to conduct an empirical study/estimate, a period of 5 years is preferred because it is consistent with a regulatory control period.

5.5 Draft Guidelines

299. The Authority considers that gearing should be determined from the average gearing level of a benchmark sample of Australian utility businesses subject to similar risk as the regulated entity in providing the reference services.

300. Companies included in the benchmark sample used to derive a benchmark gearing level for gas regulated businesses must satisfy three criteria. *First*, the company must be a network service provider in the gas and/or electricity industry in Australia. *Second*, the company must be listed so that the market value of its equity can be estimated using available data sources such as Bloomberg. *Third*, data on the values of debt and equity must be available.

301. The Authority’s recent analysis with this method, using the updated data set from 2008 to 2012, indicates that a benchmark gearing level of 60 per cent debt is appropriate. This benchmark gearing of 60 per cent has consistently been used by Australian economic regulators over the past decade for their regulatory decisions.

6 Return on Debt

302. This chapter addresses the framework for estimating the return on debt. The chapter considers responses to the Authority's Consultation Paper released in December 2012, and also to the Secretariat's Working Paper released in June 2013.[108]

6.1 Submissions

303. With regard to the broad approach to the return on debt, points made in submissions on the Consultation Paper included views that:

- a range of approaches were possible for estimating the cost of debt, including observing the yield on debt for comparator companies, using estimates based on the embedded cost of debt, or using analysts' forecasts;[109]
- the NGR now allow for a menu of approaches to estimating the return on debt, and that firms should be able to choose from the menu to suit their approach to managing their debt portfolio;[110]
- the merits of trailing average approaches to estimating the return on debt should be evaluated as a means to address the differential between the allowance for the return on debt and the debt service costs of an efficient benchmark entity;[111]
- the cost of debt actually incurred by regulated firms could provide a starting point for identifying the efficient cost of debt, with this 'revealed cost' being treated in the same way as an operating cost.[112]

304. With regard to the efficiency considerations raised in the Working Paper, submissions included additional views that:

- the Authority has miscast the efficiency requirements of the National Gas Law, and not met the requirements of NGR 87 in relation to the return on debt;[113]
- it is not possible to compare models for the cost of debt without specifying them in detail;
- the evidence for the better predictive power of the on-the-day approach as compared to the trailing average approach is flawed;

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[108] Economic Regulation Authority 2012, *Consultation Paper: Guidelines for the Rate of Return for Gas Transmission and Distribution Networks*, www.erawa.com.au; and

Economic Regulation Authority 2013, *On the benchmark cost of debt: Efficiency considerations*, www.erawa.com.au.

[109] For example, DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, Attachment 4, p. 12.

[110] For example, Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, p. 43.

[111] Electricity Networks Association 2013, *ERA Consultation Paper – Rate of Return Guidelines*, www.erawa.com.au, Attachment A, p. 43.

[112] Major Energy Users 2013, *Rate of Return Guidelines: Comments on Issues Paper*, www.erawa.com.au, p. 30.

[113] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 6.

- in funding large tranches of debt:
  - liquidity is important, as a regulated firm will only deal with a small number of banks – this constrains the amount of swaps that can be written within a given time period;
  - penalty clauses and 'make whole' provisions mean that firms cannot refinance easily as rates go down;
- if differences arise in regulated rates of return for gas pipelines and networks between Western Australia and the east coast, this will lead to investment distortions.

6.2 Considerations of the Authority

305. A range of approaches is possible for estimating the return on debt.

6.2.1.1 Broad approaches

306. Three broad approaches for estimating the return on debt are:
    - estimating the cost of debt for companies with comparable risk, either in totality, or through a model of the cost of debt, for example in terms of an estimated debt risk premium over and above the prevailing risk free rate;
    - observing the actual cost of debt of the regulated firm, either embedded in its books or by observing the yield on recent bond issuances;
    - using analysts' forecasts of the cost of debt relating to the regulated firm.

307. The Authority considers that the second and third approaches would not be consistent with evaluating efficient financing costs associated with the benchmark firm. Further, the Authority considers that the third approach could not be 'implemented in accordance with best practice', as analysts' forecasts are often not transparent in terms of the method used to derive the forecast.

308. With regard to the first approach, the Authority notes that it could observe the *total return* on debt for companies of comparable risk. However, observations for the total cost of debt will have differing underlying risk free rates, given the different terms to maturity. This matters, because the Authority considers that basing the return on debt on prevailing conditions applying at the time of the decision is a pre-requisite for promoting economic efficiency.

309. The Authority considers that it is more transparent to base its estimate on a model of the cost of debt. The accepted model is to base the cost of debt on a risk premium over and above the risk free rate:

    Cost of Debt = Risk Free Rate + Debt Risk Premium

310. This has been the Authority's approach to date. To reflect prevailing conditions, the Authority has used an estimate of the risk free rate derived just prior to its decision. The debt risk premium has been derived based on an observed sample of comparator firms with similar credit ratings as the regulated entity. The similar credit rating provides for a similar degree of risk as the benchmark efficient entity in providing the reference services.

311. The Authority considers that the debt risk premium method provides the best approach to estimating the return on debt in way that is consistent with the risks for the benchmark efficient entity.

6.2.1.2 On-the-day versus portfolio approaches

312. The Authority's current approach to estimating the return of debt is the 'on-the-day' approach, which is derived as the sum of:

- the 5 year risk free rate, averaged over 20 days just prior to the commencement of the regulatory period; and
- an estimate of the debt risk premium based on the average of an historic sample of bonds from firms with similar risk characteristics to the benchmark firm, as determined by the credit rating.

313. The recent changes to the National Gas Rules also require the Authority to consider the merits of a 'portfolio' approach, in place of the on-the-day approach, either:[114]

- the trailing average cost of debt – a long term average of historic outcomes on the overall cost of debt; or
- the hybrid approach – a base rate derived consistent with the on-the-day approach, plus a longer term average of the debt risk premium.

314. A further consideration flowing from the NGR changes relates to whether to adopt a single estimate once every five years, at the regulatory reset, or to update the cost of debt estimate annually.[115]

6.2.1.3 Efficiency considerations

315. The Authority has considered the efficiency properties of the alternative approaches to estimating the cost of debt (see Appendix 4). Economic efficiency may be considered in terms of three components:

- Productive efficiency is achieved when firms in the economy produce any given level of output at lowest input cost. Such output may include investment in capital goods, as well as production of goods and services from the existing capital stock. The following outcomes will contribute to the achievement of productive efficiency:
  - The regulated firm funds its investments utilising the lowest input cost of debt, which reflects the prevailing interest rates that are consistent with efficient financing costs.
  - As a corollary, the regulated firm delivers its investments in the way that results in the highest net present value, using a hurdle rate that reflects the prevailing cost of funds at the time the investment decision was made.
- Allocative efficiency is achieved when the economy produces only those goods and services which are most valued by society. This occurs at the point where the marginal cost of producing a good or service just equals

[114] NGR 87(10).

[115] NGR 87(9).

the willingness to pay for that good or service, which will be reflected in marginal revenue.[116]

- The choice between investment and consumption in the economy needs to be based on the relative value of that investment to society as a whole. This requires that alternative investments throughout the economy, including by the regulated firm, are based on the prevailing cost of funds. The cost of capital used by regulated firms – when deciding to invest in additional infrastructure – needs to be updated as market conditions change.

- Dynamic efficiency is achieved when firms make those investments which maximise the returns to the firm and society as a whole over time.

  - The firm's decision should be based on the cost of capital expected to prevail over the life of the investment. Again, the cost of capital used by regulated firms – when deciding to invest in additional infrastructure – needs to be updated as market conditions change.

316. DBP considers that 'promoting economic efficiency' does not relate to allocative and dynamic efficiency, as 'these are economy-wide concepts; one cannot speak about a firm, in isolation, being allocatively efficient'.[117] However, DBP consider that Section 24 of the NGL:[118]

> ...goes beyond what the ERA refers to as productive efficiency (ie – efficient use of inputs by the pipeline owner) to consider efficient investment in the pipeline and efficient use of its services. These, however, are very narrow components of (respectively) dynamic and allocative efficiency. In other words, the NGL and NGR quite clearly do not envisage assessment of cost of debt methodologies by general concepts of efficiency as might be found in an economics textbook.

317. The Authority considers that there is no basis for DBP's claim in its submission. The Authority is of the view that all three efficiency elements are different aspects of economic efficiency. Consistent with this view, the Authority notes that the Productivity Commission, in its recent draft report on the National Access Regime, explicitly identified these aspects when considering economic efficiency in relation to monopoly infrastructure.[119]

318. In this context, the Authority also rejects GGT's view that neither NGR 87, nor the National Gas Objective set out in Section 23 of the National Gas Law (**NGL**) indicates any requirement for assessment of the approaches based on efficiency criteria.[120] The Authority notes that it was always intended that the NGL and the NGO promote economic efficiency broadly, as this is in the long term interests of consumers:[121]:

---

[116] Users of the regulated firm's services - both upstream and downstream – make production decisions that are based on efficient prices for the regulated service. At any particular point in time, the capital used for producing the regulated firm's output is 'sunk', and therefore does not contribute to (variable) marginal costs. Use of a regulated firm's service therefore should not depend on the cost of debt.

[117] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 6.

[118] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 6.

[119] Productivity Commission 2013, *National Access Regime Draft Report*, www.pc.gov.au, p. 81.

[120] Goldfields Gas Transmission, *Submission responding to ERA cost of debt working paper,* July 2013.

[121] National Gas (South Australia) Bill 2008, *Second Reading Speech*, www.ret.gov.au, p. 4.

> The national gas objective is to promote efficient investment in, and efficient use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, reliability and security of supply of natural gas.
>
> The national gas objective is an economic concept and should be interpreted as such.
>
> The long term interest of consumers of gas requires the economic welfare of consumers, over the long term, to be maximised. If gas markets and access to pipeline services are efficient in an economic sense, the long term economic interests of consumers in respect of price, quality, reliability, safety and security of natural gas services will be maximised. By the promotion of an economic efficiency objective in access to pipeline services, competition will be promoted in upstream and downstream markets.

319. GGT also noted that prices set for pipeline services are usually multipart prices, and not prices which equate the marginal cost of service provision. With regard to this point, the Authority is of the view that generally the variable part of pricing will rise or fall in response to the overall revenue requirement, and hence that efficient financing costs will have an impact at the margin, and hence on upstream and downstream allocative efficiency.

320. The Authority considers that the longer term interests of consumers, as set out in the National Gas Objective, are clearly served by promoting economic efficiency, not just in terms of investment and supply of pipeline services, but also for upstream and downstream use (see Appendix 3).

6.2.1.4 Prediction performance

321. The Authority considers that the on-the-day approach to estimating the cost of debt has better efficiency properties as compared to either of the portfolio approaches. The on-the-day approach is more efficient because it is a better forward predictor of the prevailing interest rate for each year of the regulatory period. This has important implications for ensuring efficient investment, as it is the regulated return on debt for the regulatory period that will condition the firm's investment decision, not the firm's actual cost of debt.[122] The closer the regulated return is to the prevailing marginal cost of debt, the more efficient investment decisions by the regulated firm will be.

322. The Authority notes DBP's view that the Authority's assessment that the predictive power of the on-the-day approach as being superior to the trailing average – through use of the Diebold Mariano (**DM**) – is flawed.[123] The Authority however rejects this contention (see Appendix 6).[124]

[122] The hurdle rate for investments adopted by the firm will be its expectation of future rates over the life of the investment. The near term rates for the future will have greatest impact on the present value of the stream of future returns. Hence it is the regulated return on debt over the regulatory period (and to a lesser degree the regulated return expected over the next period), that will have greatest influence on the hurdle rate. It is worth noting that the firm will apply the expected regulated rate, as this will be its opportunity cost of debt. The corollary is that if the firm's actual cost of debt at the time of the investment is below the regulated rate, then it will receive an extraordinary return, and will have an incentive to over-invest, compared to the economically efficient outcome. On the other hand, if the firm's actual cost of debt at the time of the investment is above the regulated rate, then it will have an incentive to under-invest, compared to the economically efficient outcome,

[123] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 3.

[124] A peer review of Appendix 7 by Data Analysis Australia confirmed that the Authority had applied the DM test correctly, and that its findings about the prediction superiority of the on-the-day approach are supported. See Data Analysis Australia 2013, *Review of Risk Free Rate Calculation*, www.erawa.com.au.

323. However, DBP considers that even if the on-the-day approach was shown to be a better predictor, it does not support the argument for efficiency. DBP consider that the difference in the predicted and actual return on debt in any year bears no relation to the average predictive power over the five years. DBP suggested:[125]

> The link between predictive power and productive efficiency is even less robust. Consider a situation where the interest rate this period is five percent and the interest rate next period is known to be seven percent. What the ERA is saying, by linking predictive power to productive efficiency, is that the firm which borrows today at seven percent is more productively efficient than the firm which borrows today at five percent. This is clearly nonsense; in a competitive marketplace, the firm borrowing at five percent today will have run the firm borrowing at seven percent out of business by the time the next period comes around. [126]

324. In response, the Authority considers that if on average over the regulatory period, the regulated rate is closer to the actual rate, there would be less distortion in investment decision making by the regulated firm. This is the purpose of the DM test in relation to the predictive efficiency of the risk-free rate, and by corollary, the overall cost of debt. Less distortion in investment decisions will promote economic efficiency for a long term benefits of consumers (refer to Appendix 4).

325. Further, the Authority has also considered the simple example used by DBP, quoted above. The Authority is of the view that the firm that borrows at five per cent *today* should apply a hurdle rate of *seven* per cent to its investment decision next year, because in DBP's example it is assumed that the interest rate next year is known with certainty now. The Authority is of the view that a hurdle rate of five per cent should not be applied to the firm's investment next year. This is because, all other things equal, if the investment returns less than seven per cent to the debt, the firm is better off re-lending the five per cent money at seven per cent, thereby making two per cent on its borrowing virtually risk free. This is better than making only a five per cent return on its cost of borrowing.

326. DBP also considered that the trailing average is a 'combination of several predictions'.[127] DBP considered that predictive ability depends on the point in the interest rate cycle.[128] Further, DBP stated that:[129]

> If interest rates are a true random walk, then neither approach will predict accurately, because by definition a random walk is not predictable. If interest rates follow a random walk with a particular linear trend (upwards or downwards), then the information from the several observations in the trailing average is redundant as only the most recent information is useful in predicting where the series will go next. However, if interest rates follow a random walk with a more complex trend (mean-reverting, say, or cyclical) then the greater number of observations in the moving average may actually provide useful information about the future that is missing if only an on-the-day approach is used.

[125] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 10.

[126] DBP footnote: Moreover, if the regulator forces the firm to adopt such a rate, then it would be causing allocative inefficiencies because it would direct investment away from the firm over which it is able to exercise control.

[127] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 12.

[128] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 13.

[129] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 12.

327. However, the Authority considers that it is accepted that the current price is the best predictor of the price in the future where the data follows a random walk. This view is consistent with the Efficient Market Hypothesis **(EMH**). The Authority's statistical analysis supports this finding (refer to Appendix 6).

328. The EMH also provides theoretical support for this view.[130] The EMH concept has its foundations in the idea that capital markets are efficient. This involves the market reacting to new information in an instantaneous and unbiased manner. A corollary of this view is that investors cannot earn abnormal returns by using old 'news' to guide investment decisions. Although it has been acknowledged that the hypothesis has its limitations, it is well accepted. Ball (1994) noted that:[131]

> 'relative to the uninformed views that preceded the immensely valuable work that was done in the 1960s and 1970s we know much, even though the extensive anomalies literature of the 1980s continually reminds us that we also know little.'

329. GGT is of the view that the Authority's use of the DM test confirms what is clear from an inspection of the data: that an on-the day forecast will have a higher predictive power than the trailing average approach in the case where the rate of return has a(n) downwards/upwards trend.[132] However, GGT has concerns those certain sub-periods within the ERA's data set which have no clear trend. GGT argued that if this were to occur before an access arrangement, no general conclusion could be drawn as to the superior predictive performance of the 'on-the-day' approach. In addition, GGT noted that no analysis has been performed by the ERA on the debt risk premium component of the cost of debt.

330. The Authority response is that the longest possible period of the risk-free rate was adopted in the DM test to compare the predictive efficiency of various averaging periods. The Authority is of the view that sub-periods with a specific trend is not a concern because the purpose of the DM test is to identify the best approach given the long term behaviour of interest rates. The Authority notes that apparent trends are common in random walk series, *ex post*, but that we are concerned with prediction, ex ante. Under a random walk, the most recent observation provides the best predictor for the near future.

6.2.1.5 *Staggering of a portfolio of debt*

331. The on-the day approach has been criticised on the basis that it somehow does not allow firms to establish a debt portfolio with maturities that are staggered over time in order to avoid 'refinancing risk' (also known as debt laddering).[133] The Authority considers that this view is incorrect.

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130 Fama (1970) reviewed the theory and empirical work on efficient capital markets, defining an efficient capital market as that in which prices always 'fully reflect' all available information (see Fama E.F 1970, 'Efficient Capital Markets : A Review of Theory and Empirical Work', *The Journal of Finance,* Vol 25 No. 2, p. 383-417). The EMH was tested using three information sets:

- weak-form tests used historical prices;
- semi-strong tests used publically available information such as announcements of stock splits, dividends;
- strong-form tests were based on privately available information.

The first two were not rejected based on available evidence, while some evidence existed against strong-form efficiency.

131 Ball, R., (1994), *The development, accomplishments and limitations of the theory of stock market efficiency'*.

132 Goldfields Gas Transmission 2013, , *Submission responding to ERA Cost of Debt Working Paper*, www.erawa.com.au, p. 4.

133 The Authority notes DBP's argument that staggered debt is not adopted to avert refinancing risk (see DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working*

332. The Authority notes that this view is predicated on the idea that the firm is unable to hedge its existing portfolio of staggered debt to reflect the on-the-day approach. The implied view is that the regulated firm must issue all of its debt in the averaging period, just prior to the regulatory period.

333. However, the Authority considers that regulated firms may issue debt at any time, and may hedge the risk free rate by undertaking interest rate swaps just prior to the regulatory period, in order to convert to the rate that reflects the prevailing on the day risk free rate adopted as the regulatory return on debt.[134]

334. The Authority has not been presented with concrete evidence of impediments to hedging the risk free rate (and a component of the debt risk premium), through the use of interest rate swaps.

335. *First*, the swaps market is extremely liquid. The Australian Financial Markets Association **(AFMA)** provides an indication as to the liquidity of the interest rate swap market in Australia by collecting data from market participants on the total amount of Interest Rate Swaps Outstanding.[135] Of interest is the amount of fixed for floating interest rate swaps available as this allows regulated entities to hedge their interest rate exposure. In particular, the Authority notes that the largest volume of interest rate swaps outstanding occur for a maturity of less than 1 year, implying that firms are easily able to hedge on an annual basis (Figure 2).

Paper, www.erawa.com.au, p. 14). DBP also stated that it considered that refinancing risk is borne by the borrower and that the default risk is born by the lender.

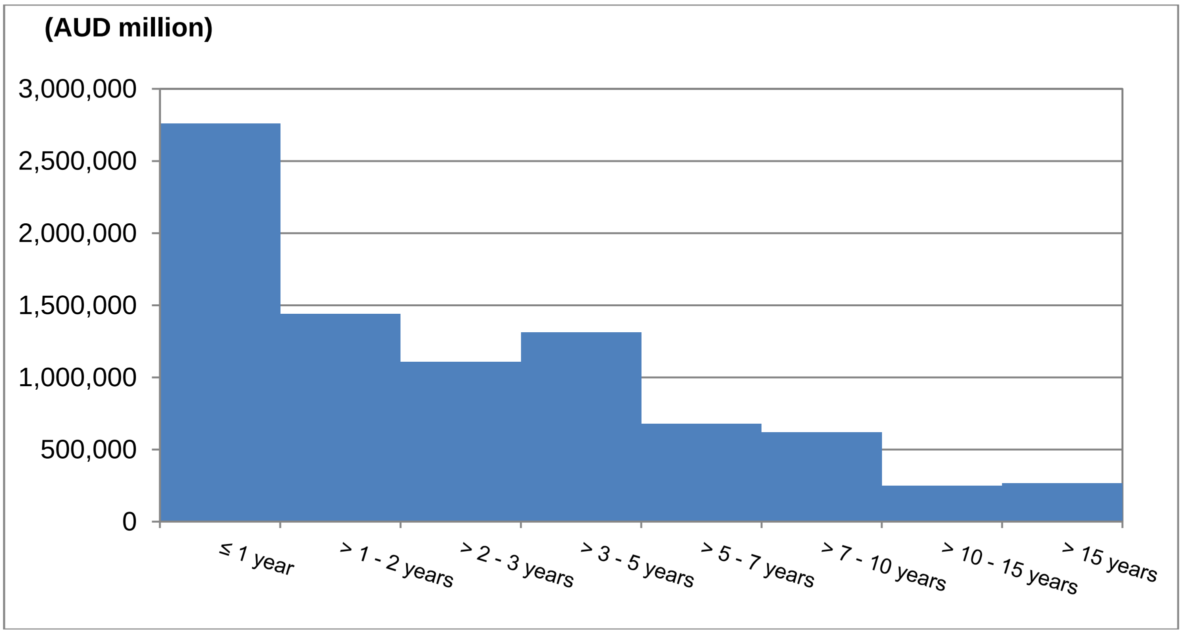
The Authority notes that while default risk is borne by the lender, it will pass on this expected cost to the borrower when the credit spread is determined. As such, the borrower also bears the consequences of its default risk. Similarly, a lender will take refinancing risk into account in the pricing of debt.

The Authority is of the view that both likelihood of default risk and refinancing risk is considered in the assigned credit rating by rating agencies. As such, the Authority's bond-yield approach is a valid approach to determine the cost of debt for regulated businesses with similar risk of a benchmark efficient firm – which is directly observed from the benchmark sample.

[134] The Authority notes that use of interest rate swaps will hedge both the risk free rate and a component of the debt risk premium. See Appendix 5 and also Chairmont Consulting 2013, *Comparative Hedging Analysis*, www.erawa.com.au.

[135] Australian Financial Markets Association 2013, Australia, accessed 23 July 2013, www.afma.com.au/data/afmr.html.

Figure 2 Fixed for Floating AUD Interest Rate Swaps Outstanding as at 31 May 2012.



Source: AFMA, ERA analysis.

336. *Second*, the Authority notes that its consultant, Chairmont Consulting, advises that transacting $2 billion of swaps in 20 days, in normal circumstances, would not 'move the market' price of swaps.[136] This equates to an average of $100 million of swaps per day.

337. *Third*, Frontier Economics set out the view that:[137]

> ...it does not seem to us that periodic resetting of allowed returns by a regulator should compel businesses to refinance all their debt all at once. The important question is whether the businesses are able to hedge interest rate risk and refinancing risk effectively. It is not obvious to us that large networks are necessarily disadvantaged in terms of their ability to manage these risks using instruments such as IRSs, but we remain open to considering evidence to the contrary.

338. The Authority considers that these points undermine DBP's contention that, in funding large tranches of debt, a regulated firm will only deal with a small number of banks, and that somehow this constrains the amount of swaps that can be written within a given time period.[138] DBP makes this assertion, but provides no evidence.

339. Similarly, the Authority has also noted Western Australia Treasury Corporation's (**WATC**) views.[139] In particular, WATC has suggested that Chairmont Consulting

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[136] Chairmont Consulting 2013, *Comparative Hedging Analysis*, www.erawa.com.au, p. 19.

[137] Frontier Economics 2013, *Assessing risk when determining the appropriate rate of return for regulated energy networks in Australia*: *A Discussion Paper prepared for the AER*, provided as part of workshop materials, p. 36.

[138] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 19.

[139] Western Australian Treasury Corporation (WATC) in its submission suggested that the estimate of the DRP and the cost should account for the size of the regulated business, and the volume of the debt that must be refinanced (see Western Australian Treasury Corporation 2013, *Rate of Return Guidelines Review*, www.erawa.com.au, p. 1). WATC argued that liquidity constraints will not allow large entities to refinance or restructure (swap) all their debt within a short time window of 20 trading days. As such, WATC argued that

did not consider the impact of hedging notional amounts over $1bn over a 20 day period would move the swap rate and this should be considered a transaction cost over and above that of 'efficient financing'.[140] However, Chairmont Consulting is clear that the swaps market is sufficiently deep, although it notes that this is dependent on the market situation.

340. Nevertheless, even though firms may hedge floating rate debt through base rate swaps, the Authority notes that the practice of staggering debt may increase 'mismatch timing risk' with regard to the component of the debt risk premium that is not able to be hedged through interest rate swaps.[141] Mismatch timing risk derives from having revenue based on an assumption of the cost of debt that differs from the cost of debt that the firm actually incurs. However, the Authority considers that this risk is one that is faced, to an extent, by both regulated and non-regulated firms.[142]

341. Non-regulated firms operating in competitive markets face the mismatch timing risk associated with prevailing interest rates – that are unhedged – moving away from the level that underlies their revenue, and hence pricing, decisions. Non-regulated firms may hedge this risk through the interest rate swaps market, as outlined above. However, non-regulated firms will face some mismatch timing risk to the extent that they are unable to hedge the debt risk premium.[143]

342. The Authority considers that regulated firms also face a similar mismatch timing risk. However, mismatch timing risk currently is greater for regulated firms due to the artificial constraint imposed by the regulator in setting the cost of debt once every five years, at the start of each access arrangement period.

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the regulated businesses are left with significant interest rate risk. WATC also suggested that this constraint potentially gives significant power to the financial counterparties to opportunistic pricing.

[140] Western Australian Treasury Corporation, *Response to the Secretariat's Working Paper "On the benchmark cost of debt: Efficiency considerations",* July 2013. p. 1.

[141] The Authority considers that this point responds to DBP's contention that mismatch timing risk is not important, given that the firm is able to issue floating rate debt (see DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 11).

The Authority notes that Chairmont Consulting alluded to this trade-off in its report to the Secretariat (see the Secretariat's Working Paper, which includes the advice to the Secretariat from Chairmont Consulting, which may be found at www.erawa.com.au/access/gas-access/guidelines/).

The Authority also notes that DBP elsewhere in its submission explicitly acknowledged that there is a trade-off between addressing refinancing risk, associated default risk and mismatch pricing risk (see DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 19). Specifically, DBP stated that:

Like all companies, we face a price and tenor trade-off in respect of maintaining our debt portfolio. It might be cheaper to borrow money for only a year, but failure to lock in at least some of our debt over longer periods of time, means that we are much more subject to short-term interest rate fluctuations and refinancing risk. This influences our credit rating as well; if all our debt was short-term, then it is likely our credit ratings would fall, and we would pay more for our debt.

The Authority also notes that DBP suggested that the trade-off between re-financing risk and mismatch timing risk can be tested by development of a model such as stochastic frontier analysis. However, the Authority considers that a model is not needed to infer the outcomes from this trade-off. Nevertheless, the Authority would be willing to consider any model presented. DBP has not presented such a model.

[142] In this context, the Authority does not accept DBP's contention that mismatch pricing risk does not exist, whether it be for the monopoly firm or the competitive firm (DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 13.). DBP suggest that mismatch timing risk has no validity from a theoretical perspective for monopoly business, as the firm has pricing power, or for pure competition, as pricing is always at marginal cost.[142] There needs to be some degree of fixed cost. DBP consider that mismatch timing risk can only occur when a firm needs to invest in one period to produce in the next, but faces a competitor which can invest and produce in the next period. The Authority considers that these arguments are internally inconsistent.

[143] The Authority notes that mismatch timing risk will lead to increased volatility for cash flows to equity.

343. On this basis, the Authority considers that the on-the-day approach is preferable, as it is 'supportive of specific regulatory aims', particularly as it more closely achieves rates of return that would be consistent with the outcomes of efficient, competitive markets' (see Appendix 4 for more detail).

344. Figure 3 illustrates this point by estimating a regulated cost of debt derived at the current time through the two approaches.[144] The prevailing cost of debt for a BBB+ entity is around five per cent, whereas a five year trailing average cost of debt would be seven per cent. This two per cent differential, if passed on to gas consumers, would reflect the mismatch timing risk that has been transferred to them, and which they are unable to manage through hedging. This cost would come at a time when consumers are facing more difficult economic conditions, which has induced the Reserve Bank of Australia to lower the cash rate. It is not clear why shareholders in regulated utilities should be insulated from these risks, via a transfer of the risk to consumers.

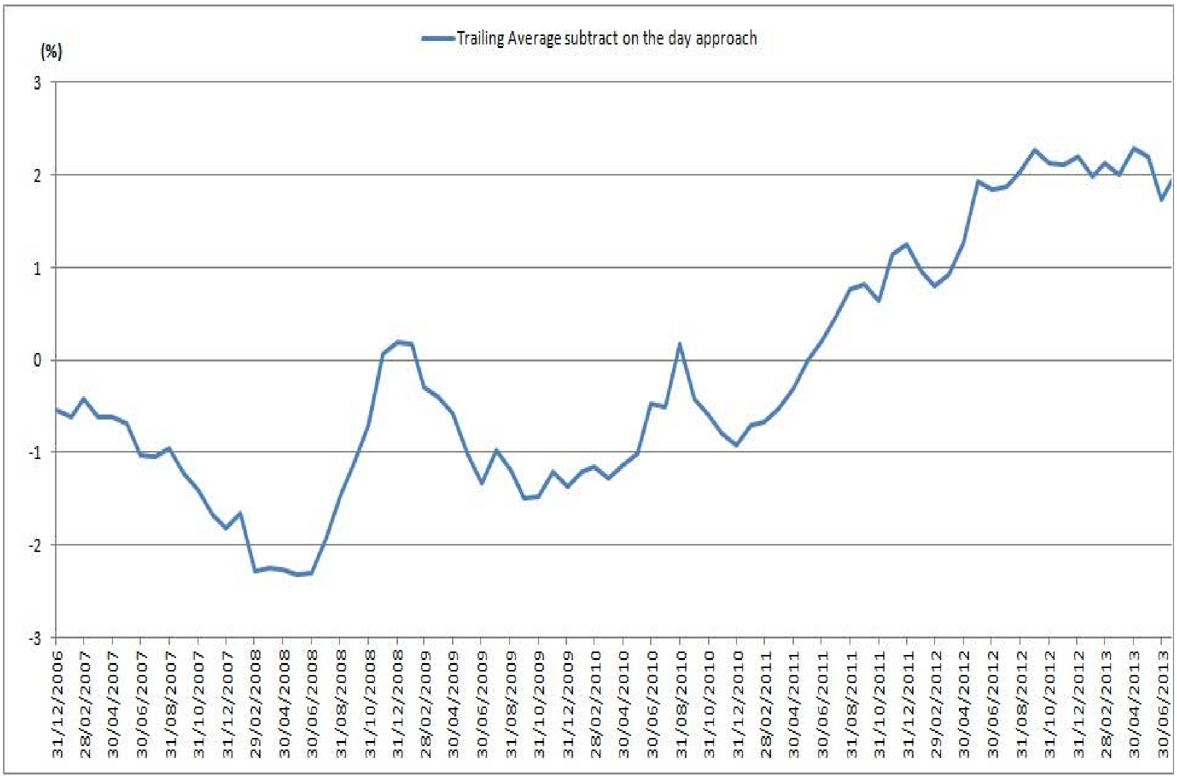
345. The Authority notes that using the 5-year trailing average approach would result in a maximum difference of 229 basis points over the prevailing cost of debt, which occurred on 30 April 2013. Conversely, the 5-year trailing average approach underestimated the prevailing cost of debt by up to 230 basis points which occurred on 29 Feb 2008. The differences of the estimates of the cost of debt using these two approaches over the period from 2001 to 2013 are presented in Figure 4.

[144] To illustrate the difference between the estimates of the cost of debt arising from the 'on-the-day' approach and the 5-year 'trailing average' approach. The Authority used Bloomberg's 5-year BBB Fair Value Curve (Bloomberg Ticker: C3565Y Index – BBB CR 5 YR Index) as a proxy for the cost of debt. The FVC was used for this comparison as Bloomberg currently does not provide a facility for collecting information on historical bonds, the bond yield approach is unable to be applied on a historical basis. The Authority calculated the estimates of the cost of debt from the "on-the-day" approach of the Bloomberg's 5-year BBB FVC by using an averaging period of 20 trading days prior to the end of each month. In relation to the 5-year trailing average, the cost of debt is estimated as a simple average of the cost of debt over the period of 5 years. This estimate is then "rolled-over" to include one more month of new data by dropping the oldest month of data in the sample. For example, the first estimate of the 5-year trailing average covers the period from 1 January 2010 to 31 December 2010. The second estimate will cover the 5-year period from 1 February 2010 to 31 January 2011 and so on. The differences between the estimates of the cost of debt using these two approaches for the period from 2001 to 2013 are presented in Figure 3.

Figure 3 Estimates of the Cost of Debt: the "On-the-day" Approach versus the 5-year Trailing Average Approach, 2001 - 2013

Source: Bloomberg and ERA analysis.

Figure 4 Differences of Estimates of the Cost of Debt under the Two Approaches



Source: Bloomberg and ERA analysis.

346. The Authority notes that using the 5-year trailing average approach would result in a maximum difference of 229 basis points over the prevailing cost of debt, which occurred on 30 April 2013. Conversely, the 5-year trailing average approach underestimated the prevailing cost of debt by up to 230 basis points which occurred on 29 Feb 2008. The differences of the estimates of the cost of debt using these two approaches over the period from 2001 to 2013 are presented in Figure 4.

6.2.1.6 A single reset at review or annual updating?

347. As noted, the mismatch timing risk is higher for the regulated firm than the unregulated firm, because of the artificial constraint of fixing the cost of debt for the regulatory period. The Authority notes that this outcome is inconsistent with its intent to be 'supportive of specific regulatory aims', and thereby 'seek to achieve rates of return that would be consistent with the outcomes of efficient competitive markets'.

348. However, the Authority considers that the mismatch timing risk for the regulated firm could be made consistent with that faced by unregulated firms if it updated the on-the-day cost of debt for each regulatory year.

349. Such an approach would:

- be consistent with NGR 87 (9)(b);
- facilitate hedging by the regulated firm of its staggered portfolio of floating rate debt through interest rate swaps;
- closely align the mismatch timing risk of the regulated firm with that faced by the non-regulated competitive firm; and
- as a consequence, enhance dynamic, allocative and productive efficiency by providing incentives for the firm to incorporate the prevailing cost of debt in its investment decisions.

350. The approach could also involve minimal transactions costs, if a once every five years 'true up' in net present value terms was applied at each regulatory reset.

351. To the extent that the mismatch timing risk of the regulated firm would then be aligned with that faced by the unregulated competitive firm, then the outcome would be consistent with efficient financing costs, and with the requirement for efficiency more generally.

352. The Authority notes DBP's contention that a five yearly true-up could lead to 'extremely pernicious' effects on the stability of prices for consumers.[145] However, the Authority considers that it would be able to amortise the true up over the subsequent regulatory periods as part of an automatic formula. In this scenario, the Authority considers that the changes in revenue and prices from one regulatory period to another, with the true up, would be similar to that which arises under the current approach. The differences compared to the current approach are likely to be small.

[145] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 7.

353. Nevertheless, the Authority recognises that it may be preferable for changes arising from the annual update to the risk free rate to be transmitted to tariffs in each regulatory year, as part of the annual tariff variation mechanism. The Authority intends to consider this issue further, in particular the construction of an automatic formula, prior to the finalisation of these guidelines.

354. The Authority also notes GGT's concerns with the proposed annual updating of the 'on-the-day' estimate of the rate of return on debt.[146] GGT suggests that this proposal conflicts with the requirements of NGR 87(9) and 87(10). However, the Authority considers that an 'automatic application of a formula' for addressing the resulting change in revenue would meet the requirements of NGR 87 (12). The Authority also considers that the requirements of NGR 87(8) and NGR 87(11) support the annual update approach.

6.2.1.7 A menu of options?

355. The Authority notes the view set out in some submissions that NGR 87 (10) requires that the regulator offer a menu of cost of debt options. The Authority does not agree with this view. The Authority considers that the Australian Energy Market Commission (**AEMC**) was quite clear that the regulator may decide on the approach(es) that meet the requirements of the NGL and NGR. For example, NGR 87(10) states that:

> ...the methodology adopted to estimate the return on debt may, without limitation, be designed to result in the return on debt reflecting:
>
> (a) the return that would be required by debt investors in a benchmark efficient entity if it raised debt at the time or shortly before the time when the AER's *decision* on the access arrangement for that *access arrangement period* is made;
>
> (b) the average return that would have been required by debt investors in a benchmark efficient entity if it raised debt over an historical period prior to the commencement of a regulatory year in the *access arrangement period*; or
>
> (c) some combination of the returns referred to in subrules (a) and (b).

356. The Authority notes that these are 'and/or', and that a single 'approach' is explicitly an option. As further support, the Authority notes that the AEMC observed in its decision that the regulator could adopt more than one approach. The Authority is of the view that this ruling *does not* require that the regulator should adopt more than one approach to determine the cost of debt:[147]

> The regulator will need to set out its approach(es) to estimating the return on debt in its rate of return guidelines. The Commission expects that the development of the guidelines will provide a forum for service providers, consumers and other stakeholders to propose different approaches to the estimation of return on debt, and for the regulator to discuss the merits of different approaches before setting out its proposed approach in the guidelines. The Commission intends that the regulator **could** adopt more than one approach to estimating the return on debt having regard to different risk characteristics of benchmark efficient service providers. Service providers will have an opportunity at the time of their determination or access arrangement to propose an alternative approach to that proposed by the regulator in the guidelines, but the service provider will need to explain why its proposed approach is better than the approach proposed by the regulator in the guidelines.

[146] Goldfields Gas Transmission 2013, , *Submission responding to ERA Cost of Debt Working Paper*, www.erawa.com.au, p. 5.

[147] Australian Energy Market Commission 2012, *Rule Determination*, www.aemc.gov.au, p. 90.

6.2.1.8 Issues in comparing the relevant models

357. In its submission, DBP considered that as the form of the trailing average is not set out, it cannot be compared to the status quo on-the-day approach. DBP considered that it is not possible to undertake a robust comparison without specifying the period of the trailing average, the weighting on different years, how the approach might work, or the transition mechanism. DBP submitted that general principles are insufficient to make the relevant assessment.[148]

358. The Authority does not agree with this claim by the DBP. The Authority considers that the assessment conducted by the Authority demonstrates that any trailing average approach – whether pure or hybrid – will perform less well in promoting economic efficiency in comparison with the on-the-day approach. The Authority is of the view that economic efficiency is a threshold issue for consideration in the context of ensuring that the long term benefits of consumers is met.

6.3 Draft Guidelines

359. The Authority will base its estimates of the return on debt on a risk premium over and above the risk-free rate:

Return on Debt = Risk Free Rate + Debt Risk Premium

360. To reflect prevailing conditions, the Authority will use an estimate of the risk-free rate just prior to the update period. The Authority is of the view that this 'on-the-day' approach for determining the cost of debt is the approach that best meets the requirements of the NGL and the allowed rate of return objective.

361. The Authority will update the on-the-day estimate of the risk free rate – each year on the anniversary of the commencement date – and publish the resulting return on debt on its website.

362. The debt risk premium will be derived based on an observed sample of comparator firms with similar credit ratings as the regulated entity. The similar credit rating provides for a similar degree of risk in providing the reference services.

363. The debt risk premium will be estimated once, at the commencement of the regulatory period. This estimate will apply for each regulatory year and will not be annually updated.

364. The return on debt estimated for the first regulatory year from the sum of the risk-free rate and the debt risk premium will apply for the duration of the regulatory period.

365. The Authority considers that it may be preferable for changes arising from the annual update to the risk free rate to be transmitted to tariffs in each regulatory year, as part of the annual tariff variation mechanism. The Authority intends to consider this issue further, in particular the construction of an automatic formula, prior to the finalisation of these guidelines.

[148] DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 10.

7 Risk free rate of return

366. The nominal risk-free rate of return is a key input to both the return on equity and the return on debt.

367. The risk-free rate is the rate of return an investor receives from holding an asset with a guaranteed payment stream (that is, there is no risk of default). Since there is no likelihood of default on risk-free assets, the return on risk-free assets compensates investors for the time value of money. In addition, this nominal risk-free rate may also include compensation for liquidity risk (for bearing higher interest rate risk on longer-term bonds).

7.1 Current Australian and international practices

368. With regard to the estimate of a risk-free rate of return in the determination of a regulated rate of return, there are three key issues. These relate to (i) the choice of the proxy for "risk-free" assets; (ii) the term to maturity for assessing the risk-free rate; and (iii) the averaging period.

369. *First*, Commonwealth Government Securities (**CGSs**) are widely used by regulators as a proxy for the risk-free rate in their regulatory decisions in Australia.

370. *Second*, different terms to maturity for the risk-free rate have been adopted by Australian regulators. Some Australian regulators use CGS with a 10-year term to maturity whereas others use CGS with a 5-year term to maturity. The Australian Energy Regulator (**AER**), for example, has adopted a 10-year term for a nominal risk-free rate of return.[149] The Authority and other regulators – including the Queensland Competition Authority (**QCA**) and the Independent Pricing and Regulatory Tribunal (**IPART**) – have adopted a 5-year term for the risk free rate.

371. *Third*, current practices by Australian regulators generally involve an averaging[150] period of 20 trading days (or a period of between 10 and 40days for the AER) as being the best proxy for a forward looking risk-free rate of return.

372. The Alberta Utilities Commission (**AUC**) has traditionally used the Consensus Economics forecast for a 10-year Government of Canada bonds in order to estimate the value of the risk-free rate of return.[151]

373. The New Zealand Commerce Commission (**NZCC**) considers that terms for the risk-free rate could be 3, 4, or 5 years, depending on the length of the regulatory

[149] Australian Energy Regulator, May 2009, *Final Decision, Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, p. 168.

[150] There are three different types of moving averages: (i) Simple Moving Average; (ii) Exponential Moving Average; and (iii) Weighted Moving Average, and they are all calculated slightly differently. However, all have a similar smoothing effect on the data, so that any sharp changes on rates are removed, and, as a result, the overall direction is shown more clearly. For simplicity, the Authority adopts the simple moving average in its calculations.

[151] Alberta Utilities Commission, December 2011*, 2011 Generic Cost of Capital, Decision 2011-474*, p. 9.

control period. NZCC used Bloomberg data on New Zealand Government bonds with corresponding terms to maturity.[152]

374. The risk-free rate of return is annually updated by the NZCC for some regulated businesses. This practice of updating the risk-free rate is also applied in the rail access regime in Western Australia, albeit under a different framework.

375. UK regulators including the Office of Gas and Electricity Markets (**Ofgem**) and the Water Services Regulation Authority (**Ofwat**) have adopted a range with the lower bound matching the 10-year average yields on 10-year Index Linked Gilts and the upper bound with reference to regulatory precedent.

376. All Australian economic regulators have adopted the CGSs as the best proxy for the risk-free rate assets in Australia. Current Australian regulatory practices in relation to the term of the risk-free rate of return are presented in Table 4.

Table 4 Terms of a risk-free rate of return in the Australian regulatory decisions

Regulator	Year	Industry	Term of the risk-free rate of return (Years)
ACCC[153]	2011	Fixed Line Services (Telecommunications)	10
AER[154]	2012	Gas Distribution Network	10
ERA[155]	2012	Electricity Distribution/Transmission	5
ERA[156]	2011	Gas Transmission	5
IPART[157]	2012	Water, sewerage, stormwater drainage and other services	5
QCA[158]	2012	Water, sewerage, stormwater drainage and other services	5
ESCOSA[159]	2012	Water, sewerage, stormwater drainage and other services	10

Source: Compiled by the Economic Regulation Authority

[152] Commerce Commission New Zealand, September 2012, *Cost of Capital Determination for Electricity Distribution Businesses to Apply to a Customised Price-Quality Path Proposal*, 2012 NZCC 25, p. 6.

[153] Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 61.

[154] Australian Energy Regulator, *Access Arrangement final decision Envestra Ltd 2013-17 Part 1,* March 2013, p. 29.

[155] Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

[156] Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p.158

[157] Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p.183.

[158] Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 485

[159] Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p.9

7.2 Summary of submissions

377. In the Authority's Consultation Paper, *Guidelines for the Rate of Return for Gas Transmission and Distribution Networks,* published on 21 December 2012, the Authority sought submissions from stakeholders on the estimates and methodology for deriving a risk-free rate of return.

378. *First*, with respect to the choice of proxy for the risk free rate, Wesfarmers Chemicals, Energy & Fertilisers submitted that the choice of the risk free asset should be a zero coupon asset. Wesfarmers suggested that coupons introduce reinvestment risk to an investor, as they have to reinvest these coupons at an uncertain future rate of return.[160]

379. *Second*, the Major Energy Users Inc (**MEU**) submitted that the averaging period used in calculating the awarded risk free rate of return should be fixed with a term longer than one month.[161] MEU reached this conclusion by providing evidence that a 12-month averaging period delivers a less volatile risk free rate, whilst delivering an outcome similar to one month averaging. The MEU also noted its concern with the difference of up to 100 basis points between a one-year averaging period and a 5-year averaging period. The MEU noted that more research is needed to examine the predictive power of differing averaging periods for the risk free rate.

380. *Third*, Goldfields Gas Transmission (**GGT**) submitted that the Sharpe-Lintner CAPM fails to reasonably estimate the cost of capital when the risk free rate is low.[162] GGT also argued that there is clear evidence that the risk-free rate and the market risk premium are negatively correlated. GGT also argued that in times of low risk free rates (such as currently observed), the market risk premium is elevated. GGT also noted that, with reference to the application of the Sharpe-Lintner CAPM, the term of risk-free rate of return is implicitly assumed to be different by regulators:

$$R_i = RF_{current} + \beta_i (RM_{historic} - RF_{historic}) \qquad (7)$$

381. GGT argued that the risk-free rate of return used in the Sharpe-Lintner CAPM must be the same to restore consistency between both risk-free rates

382. *Fourth*, in its submission on behalf of Dampier Bunbury Pipeline (**DBP**), the Brattle Group suggested the use of a forecast risk-free rate as opposed to the current risk free rate as an alternative to the current approach.[163] They noted however the lack of forecasts available for non-US regions.

7.3 Considerations of the Authority

383. As noted above, there are three key issues to consider in estimating the nominal risk-free rate of return. These three issues relate to (i) the choice of the proxy for

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160 Wesfarmers Chemicals, Energy & Fertilisers, *Rate of Return Guidelines Review,* 28 Feb 2013.

161 Major Energy Users Inc, *AER guideline on Rate of Return, Response to Issues Paper,* February 2013.

162 Goldfields Gas Transmission Pty Ltd, *Submission to Economic regulation Authority Consultation Paper: Guidelines for the Rate of Return for Gas Transmission and Distribution Networks*, 28 Feb 2013.

163 The Brattle Group, *Estimating the Cost of Debt, Prepared for Dampier Bunbury Pipeline,* 4 March 2013.

"risk-free" assets; (ii) the term to maturity of a risk-free rate; and (iii) the averaging period.

384. Each of the above three key issues relating to the estimate of the nominal risk-free rate of return is discussed in what follows.

7.3.1 The choice of the proxy for "risk-free" assets

385. Australian regulators have consistently adopted the observed yields to maturity of the CGS as the best proxy for the nominal risk-free rate of return.[164] The bonds issued by the Commonwealth Government of Australia have been considered as the best proxy for the risk-free rate assets in Australia on the following grounds:

- *First*, CGSs are essentially free from default risk. The Australian Government has consistently received the highest possible credit ratings from both Standard and Poor's (**S&P's**) and Moody's. Payments from these bonds are guaranteed by the Australian Government.
- *Second*, these bonds are the most liquid assets in Australia in terms of the volume at issuance; various terms to maturity; and narrow spreads between bid-ask yields.
- *Third*, the observed yields of these bonds are transparently recorded and reported by the Reserve Bank of Australia on a daily basis and are publicly available.

7.3.2 The term of the risk free rate

386. In most circumstances, the yield curve, which represents the relationship between the observed yields and terms to maturity, is assumed to be upward sloping. As such, the risk-free rate of return derived from observed yields on the 5-year term CGS bonds is generally lower than that obtained from the 10-year term CGS bonds.

387. The Authority adopted a term for the risk-free rate of return of 5 years in the Final Decision on the Dampier to Bunbury Natural Gas Pipeline Access Arrangement in 2011.[165] This decision was based on the following evidence:

- *First*, the "NPV = 0" principle from academic studies and consultant reports. An explanation of this principle is set out in Appendix 2.
- *Second*, the debt profiles for Australian rated utilities presented by S&P's in their industry report cards.
- *Third*, the current debt profile of Australian utilities.

388. Each of these three grounds is reconsidered based on recently available data and evidence.

[164] See Blanco, Brennan, and Marsh 2005, "An Empirical Analysis of the Dynamic Relation between Investment-Grade Bonds and Credit Default Swaps", *The Journal Of Finance*, Vol. LX, no. 5 October, p2261, for details.

[165] Economic Regulation Authority, October 2011, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, p.186

7.3.2.1 The "NPV = 0" principle is important to determine the term of a risk-free rate in the regulatory decisions

389. The Authority is of the view that it is appropriate to place weight on the theoretical consideration in which the "NPV=0" principle requires that the term of a risk-free rate of return should be equal to the length of a regulatory control period which is generally 5 years in Australia. The 'NPV=0' principle is required to ensure that regulated businesses are not over- or under-compensated.

390. The Authority agrees that assets used in utilities sector do have very long lives of approximately 30-50 years. However, the regulatory cycle generally requires prices to be reset every 5 years. As such, the return on these long-life assets should be compensated via multiple 5-year periods during which a rate of return is estimated.

391. The Authority is aware that regulated utilities may not be able to completely hedge all financing or refinancing to ensure all costs are compensated in the year they arise. As such, in those years, the "NPV = 0" principle does not hold. However, future interest rates can move in any direction. The Authority is of the view that, over time, these under- and over-compensations will be cancelled out. As such, it is reasonable to assume that the "NPV = 0" principle does hold on average.

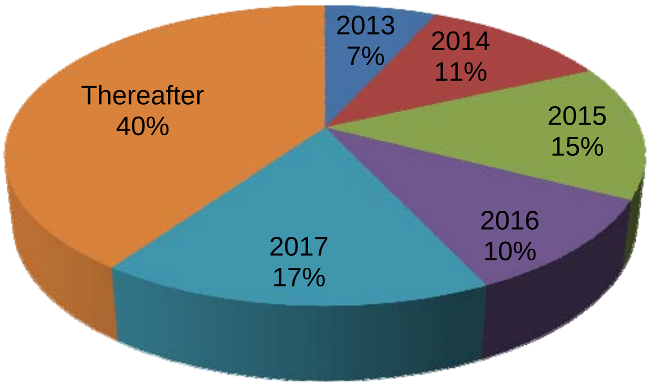
392. The Authority is not persuaded by the argument that because the long-life assets of 30-50 years used in utilities sector, a term of 10-year risk-free rate should be used. While analysis has supported a term of 5 year, the Authority is not aware of independent academic studies which objectively support a term of 10 years for the risk free rate. In addition, the term to maturity for each bond issued by the Commonwealth government varies. As at June 2013, the Authority notes that the longest maturity date for the CGS is approximately 16 years. This bond will mature on 29 April 2029.

7.3.3 S&P's Debt profiles for Australian rated utilities

393. S&P's industry report cards presented that, as at December 2012, the average term to maturity of debt raised by Australian rated utilities is approximately 5 years as presented in Figure 5 below.

394. The Authority acknowledges that the term of debt at issuance is generally longer than the term of debt to maturity captured at any point in time of a business's debt profile. However, the Authority is of the view that a combination of various short-term debt (e.g. bank loans) and long-term debt (e.g. bonds) is required to ensure that businesses will not be exposed to liquidity issues in the short run as well as solvency concerns in the long run. This debt structure also contributes to a reduction in refinancing risk. The debt structure of a particular business is expected to remain relatively constant across various periods. As such, the Authority is of the view debt profiles of Australian rated utilities presented in S&P's industry report cards reflect the preferred debt structures of rated utilities. This is detailed in Figure 5 below.

Figure 5 S&P's Current Debt Profile for Australian Rated Utilities as at December 2012



Source: S&P's Industry Report Card 2012

7.3.4 Current debt profile of Australian utilities

395. The Authority has also conducted analysis of current debt profiles of Australian utilities as at March 2013.

396. A sample of Australian gas and electricity network service providers (**NSPs**) bonds outstanding in March 2013 was sourced from Bloomberg. The sample includes bonds issued in domestic and foreign markets. The sample consists of 111 instruments. Table 5 presents the outcomes.

Table 5 Australian Gas and Electricity Network Service Provider Bonds as at March 2013

Company	Number of issuance
SPI Australia Assets	12
PowerCor Australia	5
SPI Electricity and Gas	18
ETSA Utilities Finance	5
APT Pipelines	20
DBNGP Finance Co	2
SP Powerassets	16
United Energy Distribution	4
DBNGP Finance Co	4
Energy Partnership Gas	2
CitiPower	2
Envestra	1
Envestra Limited	2
Jemena	8
Envestra Victoria	1
Singapore Power	1
Electranet	1
TXU Australia	3
SPI Electricity	4
Total	**111**

Source: Bloomberg

397. The average term to maturity for bonds at issuance was approximately 10 years while the average of the remaining term to maturity was approximately 5 years as presented in Figure 6 and Figure 7 below.

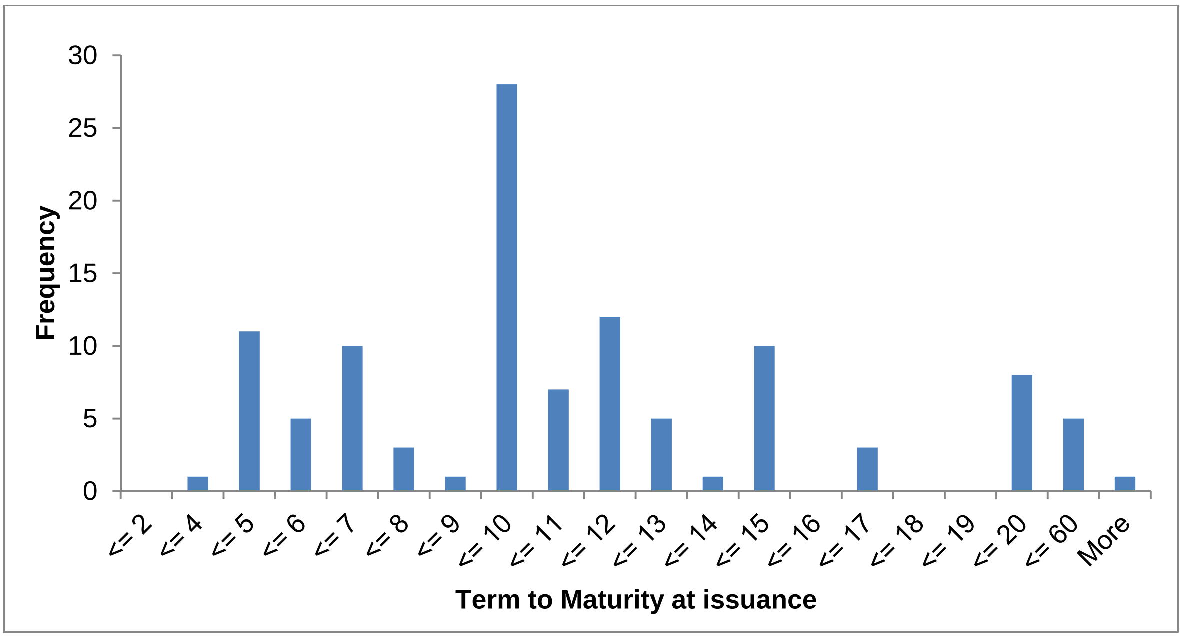
398. Table 6 presents a summary of descriptive statistics for all Australian Electricity and Gas NSPs Bonds.

Table 6 Descriptive Statistics – Australian Electricity & Gas NSPs Bonds

	Term to Maturity at Issuance	Remaining Term to Maturity
Mean	11.5	6.0
Median	10.0	4.5
Mode	10.0	3.7
Amount-Issued Weighted Average	11.16	6.43

Source: Bloomberg & the Economic Regulation Authority's analysis

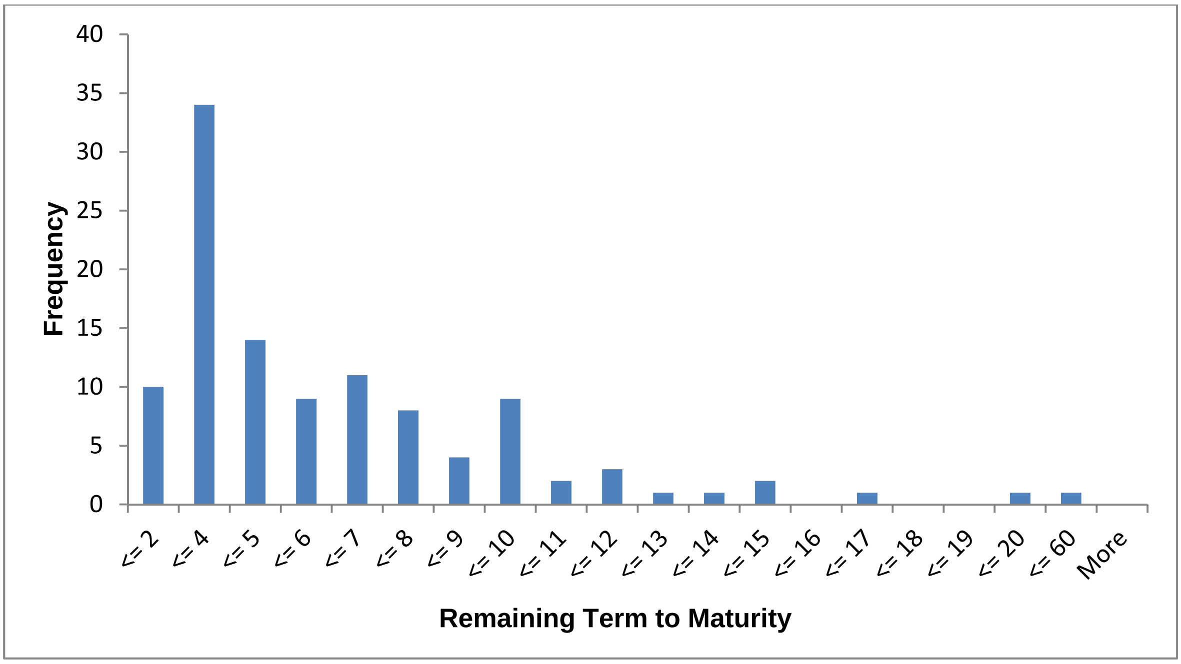
Figure 6 Terms to maturity at Issuance: Australian Gas and Electricity NSPs Bonds as at 2013



Source: Bloomberg

399. The above analysis shows that overall, network service provider (**NSP**) instrument's term to maturity at issuance tend to centralise around 10 to 11 years while the remaining term to maturity tends to centralise around 4 to 6 years. This outcome is consistent with what would be observed if an NSP issued 10 percent of its debt every year with a maturity of 10 years; the average remaining term to maturity would be 5.5 years.

Figure 7 Remaining Terms to maturity as at 2013: Australian Gas and Electricity NSPs Bonds



Source: Bloomberg

400. The Authority considers that it is the average remaining term to maturity that determines the debt profile of a firm at a given time. That is, the yield required to service a firm's cost of debt is a function of the remaining term to maturity, and not the term to maturity at issuance. Investors will price bonds based on the coupons they are eligible to receive, the face value of the bond and the credit risk of the bond issuer. The prior history of the bond does not determine the current market value of a bond, and therefore does not determine the current market value of a firm's debt. Therefore, the term to maturity at issuance is irrelevant for the pricing of a firm's debt, and consequently irrelevant for determining the relevant term to maturity for estimating the risk-free rate of return.

401. The sample was then split into domestic and foreign issued bonds to examine any differences between the two markets. Table 7 shows that domestic issues had a longer term to maturity at issuance and the remaining term to maturity in comparison with the entire sample of bonds issued in both domestic and foreign markets. The longer remaining term to maturity mainly reflects an unusually large and long issuance by APT Pipeline for $515 million over a term of 60 years in late 2012. Without this bond the remaining term to maturity in this sample has a mean of 5.6 years, median of 4.3 years and mode still of 7 years. The amount issued weighted average decreased substantially to 5.37 years. This is consistent with expected average term being 5.5 years.

Table 7 Australian Electricity and Gas NSPs Bonds issued in domestic markets

	Term to Maturity at Issuance	Remaining Term to Maturity
Mean	10.8	6.8
Median	10.0	4.3
Mode	5.0	7.0
Amount-Issued Weighted Average	11.60	7.59

Source: Bloomberg & the Economic Regulation Authority's analysis

402. When the bonds at issuance in the international markets are considered, the mode in Table 8 shows that longer term bonds are the most common. Again, the results tend to centralise around 4 to 6 years.

Table 8 Australian Electricity and Gas NSPs Bonds issued in foreign markets

	Term to Maturity at Issuance	Remaining Term to Maturity
Mean	11.9	5.5
Median	10.3	5.1
Mode	10.0	3.7
Amount-Issued Weighted Average	11	5

Source: Bloomberg & the Economic Regulation Authority's analysis

403. The Authority acknowledges that the above analysis presents a 'snap shot', not a complete picture of NSP debt profiles. The above results for remaining term to maturity however, are not inconsistent with the theoretical situation where a 5.5 year term to maturity is averaged by issuing 10 per cent of debt every year with a maturity of 10 years. The Authority considers that businesses can issue bond at any time that suits them best. As such, the remaining time to maturity for bonds is relevant to determine the debt profile of a business and then the average cost of debt is determined accordingly, based on the current debt profile.

404. Taking account of the above analysis with regard to current debt profiles of Australian electricity and gas NSPs, the Authority is of the view that the current debt profile is not inconsistent with the term of 5 years. As such, given that the available evidence does not contradict the 5-year term as implied by the 'NPV=0' principle,[166] the 5-year term to maturity will be adopted for the purposes of estimating the risk-free rate of return.[167]

[166] Refer to Appendix 3 for a discussion on the NPV=0 principle.

[167] As noted by Lally, in the situation of a five year regulatory period, where firms *borrow* for a tenure of 10 years and utilise interest rate swaps, but credit default swaps are not readily available, the appropriate cost of debt to be awarded is: i) a five-year risk free rate, (ii) annualised 10-year debt issuance costs, (iii) ten-year debt risk premium; and (iv) the transaction costs involved in swap contracts. Lally noted that in this scenario, whilst the "NPV=0" principle would be violated, it would lead to a slight deviation of approximately 0.04 per cent of the WACC per year. The implication of this analysis is that where the debt risk premium cannot be hedged, then it is appropriate to calculate it based on the actual term of debt issued by the benchmark firm. Even when this is longer than five years, the resulting violation of the NPV=0 condition is extremely small. See Lally M. 2010, *The Appropriate Term for the Risk Free Rate and the Debt Margin,* April 2010.

7.3.5 The averaging period

405. Australian economic regulators have to date adopted an averaging period of 10-40 trading days just prior to the release of the regulatory decisions.

406. The Authority has conducted its own analysis and concluded that an averaging period of 20-trading days just prior to the release of the regulatory decisions is still the best proxy for the forward looking estimate of the risk free rate for the subsequent regulatory period of 5 years.[168] For further details, refer to Appendix 6.

7.3.6 Evaluation

407. Current Australian regulatory practice indicates that the risk-free rate of return is estimated using linear interpolation of the observed yields from two Commonwealth Government bonds. The Authority is not aware of any other method for deriving a risk-free rate of return which is widely adopted in Australia. As such, the Authority considers that it is appropriate to continue using the current approach of estimating a risk-free rate of return for the purpose of this rate of return guidelines.

7.3.6.1 Proxy for the nominal risk free rate

408. As previously discussed, the Authority is of the view that CGS issued by the Australian Commonwealth Government is still the best proxy for a risk-free rate of return. The Australian Government has consistently achieved the highest possible credit rating of AAA from all international rating agencies including Standard & Poor's' Moody's; and Fitch. As such, its assets should be considered as risk free (or free of default) in Australia.

409. The Authority notes that other possible proxies which have been proposed by regulated businesses and their consultants, as previously discussed, were also considered in the Authority's previous regulatory decisions. The Authority has not received any proposals in response to its Consultation paper with regard to any viable alternatives to CGS. As such, the Authority is of the view that CGS is still the best proxy for a risk-free rate asset for the purpose of this rate of return guidelines.

410. The Authority's recent analysis indicates that the prevailing risk-free rate is a better proxy for a forward looking estimate of the risk-free rate during the next regulatory control period of 5 years. Using the prevailing risk-free rate will lead to outcomes consistent with those for the competitive markets, which better serve the long term interest of consumers. As such, the Authority is of the view that the prevailing risk-free rate, given by the 5-year term CGS, should continue to be used for the purpose of this rate of return guidelines.

411. The adoption of a 5-year term for the risk-free rate of return ensures that the principle of "NPV = 0" holds. In addition, current financing practice of Australian firms also indicates that a 5-year term is appropriate. As such, the Authority considers that it is appropriate to continue using a 5-year term for the risk-free rate.

[168] Economic Regulation Authority, September 2012, *Final Decision on Proposed Revisions to the Access Arrangement for the Western Power Network*, pp. 659-666.

7.3.6.2 Use of zero-coupon bonds

412. The Authority agrees with the submission from Wesfarmers that coupons paid by the bonds introduce reinvestment risk to an investor because they have to reinvest these coupons at an uncertain future rate of return. However, the Authority is of the view that, in deriving an estimate of a risk-free rate of return, the fundamental issue is to determine the most appropriate proxy for a risk-free rate of return which is considered a return from a risk-free asset. In the Australian context this is deemed to be the yield on Commonwealth Government Securities as reported by the Reserve Bank of Australia. The issue of coupon bonds versus zero-coupon bonds is a second-order issue.

413. The Authority notes that, in the AER's WACC Review in 2009, the bank bill swap rate (**BBSW**) was proposed as an alternative proxy for CGS by the Competition Economists Group (**CEG**). However, CEG has since withdrawn this proposal on the basis that it is unreliable. The Authority agrees with the AER's view that this decision by CEG indicates the lack of persuasive evidence for moving away from the CGS yield as the proxy for the risk free rate and, indeed, the inherent risk of doing so.[169]

414. In addition, the Authority also notes, during the AER's WACC Review in 2009, there were proposals to depart from the use of CGS as a proxy for the risk free rate by using either:[170]

- yields on Commonwealth government guaranteed bank debt;
- yields on State government debt; or
- the current implied breakeven inflation rate as implied by Fisher's equation.

415. In its previous regulatory decisions on DBNGP's proposed access arrangement, the Authority discussed these proposals in detail. The Authority was of the view that there was not sufficient evidence to depart from the use of CGS as a proxy for the risk-free rate of return. The Authority retains this decision for the purpose of this rate of return guideline. This decision is consistent with all other Australian regulatory decisions.

416. Given all CGS bonds are coupon bonds; the Authority considers that it is appropriate to continue using the observed yields on CGS as a proxy for the risk-free rate of return.

7.3.6.3 An appropriate term of an averaging period of a risk-free rate of return

417. The Authority agrees with MEU's submission on the importance of the predictive power of various averaging periods for the risk-free rate of return. The Authority acknowledges the importance of price stability in regulatory decisions, both with respect to avoiding price shocks to consumers and idiosyncratic market events that have short term impacts on the cost of capital. However, the Authority also recognises that a trade off between stability and efficiency considerations. In particular dynamic and allocative efficiency is fundamental to both producers and

[169] Australian Energy Regulator, May 2009, *Final Decision, Review of the weighted average cost of capital parameters for electricity transmission and distribution network service providers*, pages 130-135.

[170] Australian Energy Regulator, May 2009, Final Decision, *Review of the weighted average cost of capital parameters for electricity transmission and distribution network service providers*, pages 136-140.

consumers long run interests and is better achieved through a risk free rate that matches the current prevailing rate as closely as possible.. Estimates of the regulated rate of return must be efficient in these respects so as to mimic the outcome of a competitive market over the long term. This is consistent with the current National Gas Objective:

> The objective of this Law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.

418. This point is addressed in more detail in the debt risk premium chapter.

419. The Authority's recent study indicates that the current practice adopting an averaging period of 20 trading days is still the best proxy for the risk-free rate of return for the next regulatory control period of five years. There is no evidence to support a move from this current practice. More detail of this analysis can be found in details in Appendix 7.

7.3.6.4 *A consistent risk-free rate of return should be used in the Sharpe-Lintner CAPM*

420. Sharp-Lintner CAPM explains the expected return, $E(r_t)$, on any financial asset i in terms of the rate of return on a risk-free asset, r_f, and a premium for risk, $MRP \times \beta_i$, where **MRP** represents the market risk premium and β_i is the equity beta of asset i and is defined as $\beta_i = \mathrm{cov}(r_i, r_M) / \mathrm{var}(r_M)$. The return on equity assets is thus:

$$r_e = r_f + MRP \times \beta_i \qquad (8)$$

421. The Authority is of the view that the risk free rate of return outlined in the Sharp-Lintner CAPM is a forward looking estimate.

422. There is no good proxy for a forward looking MRP. Current Australian regulatory practice indicates that a forward looking MRP is estimated using various approaches. One of these approaches is using historical *data on equity risk premiums, which* is the difference between the market return and the return on CGS bonds (or risk-free rate). However, this approach is based on the view that past experience will provide an indication of future expectations and has gained support for being transparent, extensively studied and the results are well understood. The contention that the risk free rate is negatively related to the MRP has been raised with reference to overseas markets such as the United States and United Kingdom. Detailed discussions on this and various approaches to estimating the MRP can be found in chapter 11 - Market risk premium.

423. The Authority is of the view that there is no inconsistency between its approaches for estimating the MRP and the risk free rate of return in its regulatory decisions.

7.3.6.5 *Analysts' risk-free rate of return forecasts*

424. The Authority notes that DBP and its consultants have not provided any evidence to substantiate their proposal in which analysts' forecast risk-free rate should be used in deriving a risk-free rate of return for the rate of return guidelines. In addition, DBP's consultant, the Brattle Group, also submitted that forecast risk-

free rates of return are not available in Australia. As such, the Authority is of the view that using a forecast risk-free rate of return is not appropriate for the purpose of this rate of return guidelines.

7.4 Draft Guidelines

425. The Authority notes there are three key issues to address when estimating the nominal risk-free rate of return: (i) the choice of proxy for “risk-free” assets; (ii) the term to maturity of a risk-free rate; and (iii) the averaging period.

426. The Authority considers that Commonwealth Government Security (**CGS**) bonds are the best proxy for risk-free assets in Australia. Accordingly, observed yields from these CGS bonds – as reported daily by the RBA – will be used for the purpose of estimating a risk-free rate of return.

427. A 5-year term to maturity, informed by the observed yields on 5-year CGS bonds, will be used to estimate the risk free rate of return.

428. An averaging period of 20 trading days, prior to the release of the regulatory decision, will be adopted for the purpose of determining the risk-free rate of return in this rate of return guidelines.

8 Benchmark Credit Rating

429. The benchmark credit rating is a key input for the estimate of the DRP.

430. The risk free rate of return, the term of the risk-free rate of return and of the debt risk premium should be equal to the length of the regulatory control period, which is generally 5 years in Australia.

431. As a general rule, the DRP is higher (lower) when the credit rating is lower (higher). This is because lenders (investors) require increased (decreased) compensation before they commit funds to the debt issuer with a lower (higher) credit rating. A lower credit rating can be associated with the higher risk of default which leads to the higher DRP.

432. In the 2009 Weighted Average Cost of Capital (**WACC**) Review, the Australian Energy Regulator (**AER**) noted a strong precedent for the use of a BBB+ credit rating for energy businesses among Australian regulators. In that Review, the AER also conducted analysis for an appropriate credit rating for a network service provider. The AER concluded that a credit rating of BBB+ is appropriate[171] for the sample of electricity and gas transmission and distribution businesses in Australia.[172] In addition, the AER was of the view that electricity networks are close comparators to the benchmark efficient gas network service providers. As a result, the AER has adopted a credit rating of BBB+ in all its decisions for both electricity and gas regulated businesses since its 2009 WACC Review.

433. The Authority adopted a credit rating of BBB/BBB+ in all three regulatory decisions for gas businesses in Western Australia. In its most recent decision in relation to Western Power, the Authority adopted a credit rating of A- based on an updated sample of Australian energy businesses.[173]

434. Current Australian regulatory decisions in relation to the benchmark credit rating are presented in Table 9 below.

[171] The AER adopted the median credit ratings and the "best comparators" approaches in this Review. The AER observed a range of credit ratings from BBB+ to A- among the sample of energy businesses considered and concluded that the median approach suggests that the credit rating for a benchmark efficient network service provider may be A- (AER's WACC Review, p. 284). Also, the AER considered that ElectraNet, with the credit rating of BBB+, is the most appropriate "best comparator" business (AER's WACC Review, p. 386).

[172] Australian Energy Regulator, May 2009, Final Decision, *Review of the weighted average cost of capital parameters for electricity transmission and distribution network service providers*, pages 385-386.

[173] Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

Table 9 Benchmark credit rating in the Australian regulatory decisions

Regulator	Year	Industry	Credit Rating
ACCC[174]	2011	Fixed Line Services (Telecommunications)	A
AER[175]	2012	Gas Distribution Network	BBB+
ERA[176]	2012	Electricity Distribution/Transmission	BBB/BBB+/A-
ERA[177]	2011	Gas Transmission	BBB/BBB+
IPART[178]	2012	Water, sewerage, stormwater drainage and other services	BBB/BBB+
QCA[179]	2012	Water, sewerage, stormwater drainage and other services	BBB+
ESCOSA[180]	2012	Water, sewerage, stormwater drainage and other services	BBB

Source: Compiled by the Economic Regulation Authority

8.1 Currently available approaches to determine the benchmark credit rating

435. The Authority notes that various approaches for determining a benchmark credit rating were previously examined by the AER in its 2009 WACC Review. These techniques included: (i) ordinary least squares (**OLS**) regression techniques (as proposed by Associate Professor Lally); (ii) sample means; (iii) probit and logit regression models; (iv) sample medians; and (v) best comparators approach.

436. Details of each of these five methods are included in Appendix 9.

437. In its submission on behalf of the Joint Industry Associations, Allen Consulting Group (**ACG**) noted that the OLS regression approach used by Lally suffers from:

174 Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 67.

175 Australian Energy Regulator, *Access Arrangement Information for the ACT, Queanbeyan and Palerang gas distribution network*, 1 July 2010 – 30 June 2015 p41.

176 Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

177 Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p.158

178 Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p.197.

179 Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 498

180 Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p. 49

(i) a large number of variables affecting credit ratings not being measurable; and (ii) insufficient credit rated firms to establish a reliable estimate.[181]

438. In addition, ACG was also of the view that the use of the OLS regression and sample means methods for determining a benchmark credit rating, suffer from the problem that credit ratings are not 'equidistant'. That is, it is not easy to identify, for example, whether the increment between two adjacent ratings on the credit rating scale such as an A- credit rating is one equal increment above a BBB+ credit rating. ACG argued that applying equally-distant numerical values may incorrectly assume that each credit rating is the same equal increment above another. ACG also submitted that these two methods are also sensitive to 'outliers' or extreme values in the sample.[182]

439. The AER agreed with ACG's view on the issue. Accordingly, the AER put limited weight on the credit ratings derived using OLS regression techniques and sample averages.[183]

440. The AER was also of the view that the probit and logit regression techniques were not robust, and as such they were dismissed. The AER considered that this technique is based on insufficient observations to conduct meaningful analysis.[184]

441. Overall, the AER considered that the remaining two approaches, being the median credit rating derived from a sample of businesses and the 'best comparators' approach, were sufficiently robust to inform the benchmark credit rating.[185]

442. The Authority is of the view that the median approach, in which a benchmark credit rating is derived from a sample of selected Australian businesses, is extremely sensitive to the sample of companies used. The Authority notes that the removal and/or addition of one extra company into the sample may alter a benchmark credit rating. As such, the Authority is of the view that care must be taken when a benchmark credit rating is derived using the sample median.

8.2 The Authority's analysis of a benchmark credit rating in 2013

443. In its 2009 WACC Review on the weighted average cost of capital parameters for electricity transmission and distribution network service providers, the AER observed that publicly listed credit ratings for government-owned enterprises and businesses with financially supportive parents would tend to be upwardly biased.

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[181] The Allen Consulting Group, *Credit rating for the 'benchmark efficient network service provider', Commentary on the AER's Explanatory Statement,* Report to Grid Australia, Energy Network Association and Australian Pipeline Association, January 2009*,*

[182] The Allen Consulting Group, *Credit rating for the 'benchmark efficient network service provider', Commentary on the AER's Explanatory Statement,* Report to Grid Australia, Energy Network Association and Australian Pipeline Association, January 2009*,*

[183] Australian Energy Regulator, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters,* May 2009, p357.

[184] Ibid.

[185] Australian Energy Regulator, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters,* May 2009, p360.

The AER also noted that Standard and Poor's considers that gas networks generally face marginally greater risks than electricity networks.[186]

444. In determining a benchmark credit rating for the purpose of this rate of return guidelines for gas businesses in Western Australia, the Authority has considered a benchmark credit rating from the following samples of comparable businesses:

- A sample including both Australian gas and electricity companies (*Sample 1*);
- A sample including all privately-owned gas and electricity businesses (*Sample 2*); and
- A sample including all privately-owned gas and electricity businesses excluding businesses with support from their parent companies (*Sample 3*).

445. In this analysis, the Authority considers the median credit rating of the above samples for the period of 5 years from 2008 to 2012 using Standard and Poor's Industry Report Cards.[187] Additional resources such as Bloomberg and Moody's were referred to, in an attempt to augment the sample. However, the Authority notes that there is no additional information provided from these two sources that was not available in the Standard and Poor's Industry Report Cards.

446. A company that is included in the sample is required to satisfy two criteria. *First*, the company must be a network service provider in the gas and/or electricity industry in Australia. *Second*, its credit rating must be published by an international rating agency such as Standard and Poor's or Moody's.

[186] Australian Energy Regulator, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters,* May 2009, p390.

[187] S&P's Industry Report Cards include (i) *Australian And New Zealand Network Utilities Maintain Stable Credit Quality, November 2012; (ii) Favourable Industry Trends And Weakening Demand Place Asia Pacific Utilities In Fine Balance For The Next Six Months, November 2012; (iii) Regulatory Cloud Still Hangs Over Stable Outlook For Australian And New Zealand Utilities, May 2012; (iv) Australian Utilities Are On A Firm Footing, But Confronting Regulatory Reviews, November 2011; (v) For Australian Utilities, The Spotlight Turns To Asset Sales And Regulatory Outcomes, As Refinance Risks Moderate, May 2011; (vi) Refinancing And Balance Sheet Management Remain Top Of The Agenda For Australian Utilities, May 2010; (vii) For Australian Utilities, The Challenge Remains To Manage Refinancing And Balance Sheets, May 2009; (viii) As Risks Heat Up, Can Australian Utilities Strengthen Their Balance Sheets?, October 2008; (ix) Australian Utilities' Credit Prospects Dimmed By Looming Shadow Of M&A, Climate, And Regulatory Risks, May 2008.*

447. The Authority notes that, for the period from 2008 to 2012, the following 22 companies have satisfied the above two criteria.

1. Alinta LGA Ltd/Jemena (AGL)/Singapore Power International Assets Australia
2. Alinta Network Holding Pty Ltd/WA Network Holdings Pty Ltd/ATCO Gas Australia LP
3. The CitiPower Trust
4. DBNGP Finance Co Pty Ltd
5. DBNGP Trust
6. Diversified Utility and Energy Trusts (DUET) Group
7. ElectraNet Pty Ltd
8. Energy Partnership (Gas) Pty Ltd
9. Envestra Ltd
10. Envestra Victoria Pty Ltd
11. Ergon Energy Corporation Ltd
12. Ergon Energy Queensland Pty Ltd
13. ETSA Utilities Finance Pty Ltd
14. Gas Net Australia (Operations) Pty Ltd/APT Pipelines Ltd
15. Powercor Australia, LLC
16. SP AusNet Group
17. SPI Australia Holdings (Partnership) LP
18. SPI Electricity & Gas Australia Holdings Pty Ltd
19. SPI Electricity Pty Ltd
20. SPI PowerNet Pty Ltd
21. United Energy Distribution Holdings Pty Ltd
22. United Energy Distribution Pty Ltd

8.2.1 Sample 1: All Australian gas and electricity companies

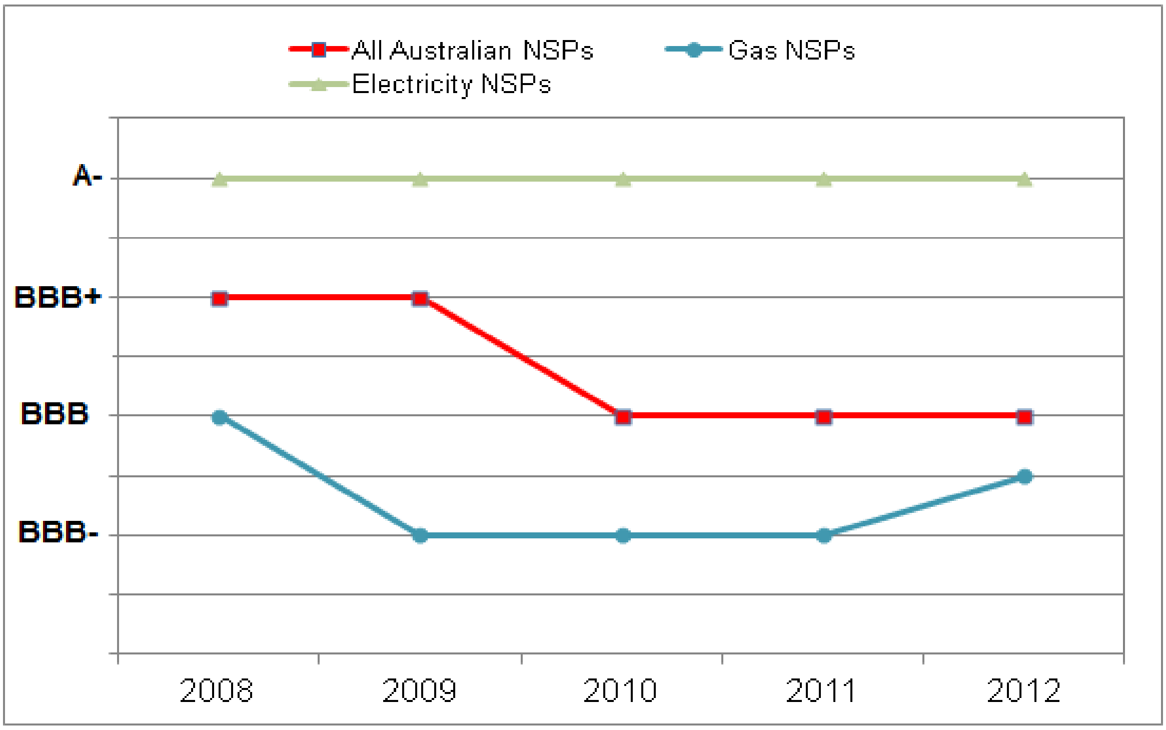
448. The Authority also notes that, for the above period from 2008 to 2012, some businesses were not rated for all years. The Authority has considered how the sample has evolved over the 5 year period from the AER's analysis in 2008.

449. A summary of this analysis on the available credit ratings for Australian gas and electricity businesses, known as *Sample 1*, is included in Appendix 8. From this summary, the Authority notes the following:

- *First*, all 22 companies in the sample have credit ratings available in 2008 and 2009.
- *Second*, only 19 companies (out of 22 companies) have credit ratings available in 2010.
- *Third*, only 16 companies (out of 22 companies) have credit ratings available in 2011.
- *Fourth*, only 14 companies (out of 22 companies) have credit ratings available in 2012.

450. Figure 8 presents the median credit rating for *Sample 1* for the period of 5 years from 2008 to 2012. *Sample 1* is a full benchmark sample. The median credit rating for all Australian gas and electricity businesses across 5 years is presented by the red line. When gas and electricity businesses are considered in isolation, they are represented by the blue line and the green line respectively.

Figure 8 Median Credit Rating of Australian Gas and Electricity Network Service Providers, 2008 – 2012, *Sample 1*



Source: S&P and the ERA's analysis

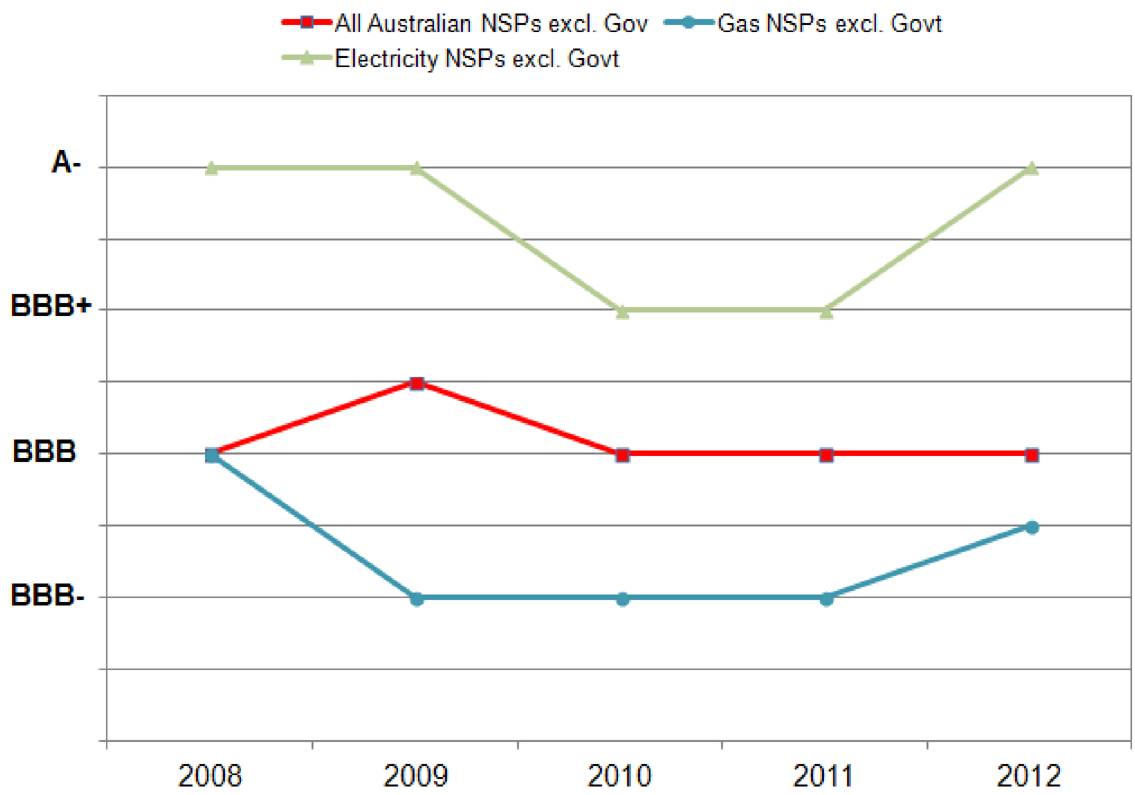
451. Figure 8 indicates the median credit rating for a full benchmark sample, *Sample 1*, including all Australian gas and electricity companies is BBB/BBB+.

8.2.2 <u>*Sample 2*</u>*: All Australian Gas and Electricity companies excluding government-owned businesses*

452. Sample 2 excludes all government-owned businesses from the full benchmark sample. A list of the companies included in Sample 2 is in Appendix 10. Figure 9 presents a median credit rating for all gas and electricity businesses over the last 5 years, from 2008 to 2012, with government owned firms excluded from the sample. The Authority notes that there are 21 companies included in this analysis beginning in 2008, dropping to 13 in 2012.

453. When the government-owned businesses are excluded from the sample, the median credit rating for the Australian gas and electricity businesses across 5 years is presented by the red line. When gas and electricity businesses are considered in isolation, they are represented by the blue line and the green line respectively.

Figure 9 Australian Gas and Electricity NSPs Excluding Government-owned firms



Source: S&P and the ERA's analysis

454. Figure 9 indicates that the median credit rating for *Sample 2* is BBB.

8.2.3 *Sample 3: All Australian Gas and Electricity companies excluding government-owned or parent-owned businesses*

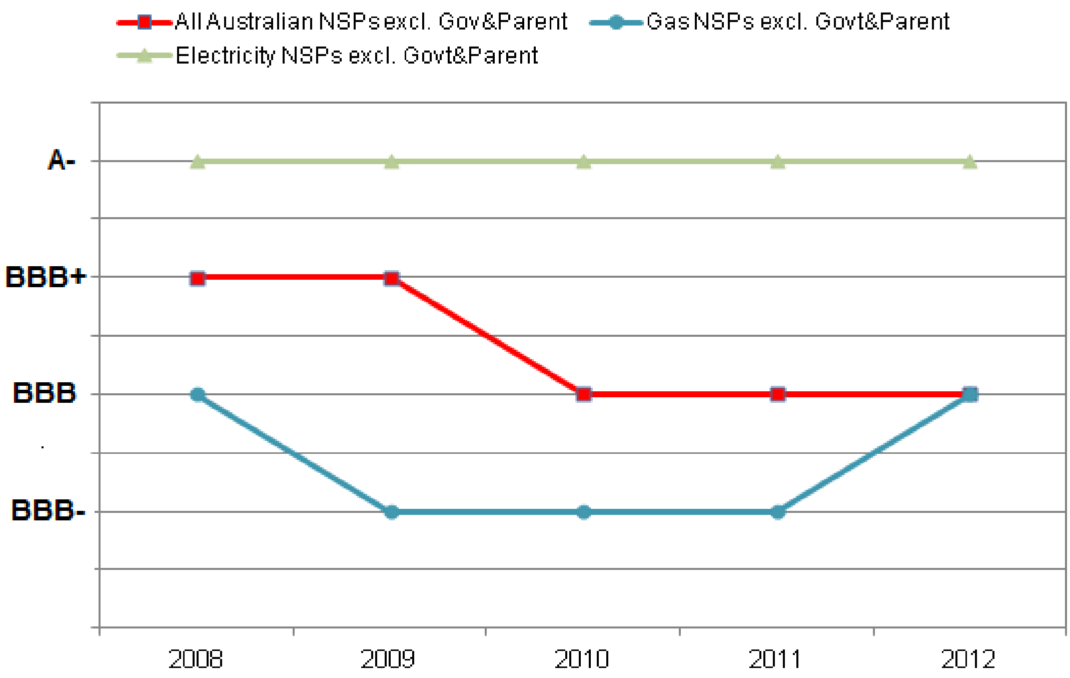
455. *Sample 3* excludes government-owned businesses or parent-owned businesses from the full benchmark sample. A list of the companies included in *Sample 3* is in Appendix 10.

456. Figure 10 presents a median credit rating for *Sample 3* over the last 5 years, from 2008 to 2012. The Authority notes that there are 19 companies from 2008 to 11 companies in 2012 included in this analysis.

457. When the government-owned and parent-owned businesses are excluded from the sample, the median credit rating for the Australian gas and electricity businesses across 5 years is presented by the red line. When gas and electricity businesses are considered in isolation, they are represented by the blue line and the green line respectively. [188]

[188] Six of the 11 companies in the All Australian NSP sample are rated BBB or lower. Although Envestra is part owned by the APT Pipeline stapled trust it is still included in the sample as it was not a subsidiary.

Figure 10 Australian Gas & Electricity NSPs excluding Government-owned and Parents-owned Companies



Source: S&P and the ERA's analysis

458. Figure 10 indicates that the median credit rating for *Sample 3* is BBB/BBB+.

8.3 Summary of submissions

459. In the Authority's Consultation Paper, *Guidelines for the Rate of Return for Gas Transmission and Distribution Networks,* published on 21 December 2012, the Authority sought submissions from stakeholders on the estimates and methodology for estimating a benchmark credit rating.

460. In its submissions, the Major Energy Users Inc (**MEU**) submitted that there is no evidence supporting the Australian regulators' decision to adopt the benchmark credit rating of BBB+ and a gearing of 60 per cent in their previous regulatory decisions.[189] The MEU stated that market evidence shows a higher gearing (i.e. debt component accounts for more than 60 per cent of the total asset) and higher credit rating (better than BBB+ credit rating) combination is possible.[190]

461. The Australian Pipeline Industry Association (**APIA**) submitted that it supports the use of a wider range of credit ratings for the purposes of calculating the cost of debt allowance.[191]

462. DBP submitted that credit ratings are imperfect indicators of the risk faced by a network service provider.[192] DBP believes that this contradicts Rule 87 of the

[189] Major Energy Users Inc. *Australian Energy Regulator, Better Regulation, Rate of Return Guidelines Comments on the Issue Paper* February 2013.

[190] Major Energy Users Inc. *Australian Energy Regulator, Better Regulation, Rate of Return Guidelines Comments on the Issue Paper* February 2013.

[191] The Australian Pipeline Industry Association Ltd, "*Response to Issues Paper, The Australian Energy Regulator's Development of Rate of Return Guidelines*", February 2013

NGR, “a similar degree of risk as that which applies to the service provider in respect of the provision of reference services”. DBP believes that the ERA is proceeding on the assumption that Rule 87 implies a need to identify the benchmark credit rating for estimating the cost of debt. DBP uses the report prepared by the Brattle Group to suggest that using the credit rating for the basis of estimating the cost of debt is insufficient, as firms will differ with respect to their coverage ratios, capital structures, cash flow variability, level of capital expenditures and business risk.

463. DBP also submitted that the S&P list of Australian utilities might be a convenient starting point for forming a benchmark sample. However, DBP consider that electricity and gas distribution entities, and electricity transmission entities are unlikely to be comparable for a gas transmission entity.

464. DBP emphasise that they disagree with using the credit rating as the key parameter in estimating the debt risk premium.

8.4 Considerations of the Authority

465. Each of the above key issues is discussed below.

8.4.1 A combination of a higher gearing and a better credit rating

466. The Authority notes that the MEU does not provide any evidence to substantiate its view. As such, the Authority is of the view that a benchmark credit rating derived from an appropriate sample of Australian businesses using a well accepted method is appropriate for the purpose of this rate of return guidelines.

8.4.2 An appropriate benchmark for Australian regulated gas businesses

467. The Authority disagrees with DBP’s view that a company’s specific risk profile should be considered when determining a benchmark credit rating for regulated gas businesses in Australia. Current practice indicates that a regulated rate of return and its input parameters are determined based on an efficient benchmark entity for the long-term benefits of consumers. In addition, as a regulated rate of return is determined to compensate the systematic risk, any unique risk incurred by a particular firm is not compensated via a regulated rate of return.

468. The Authority considers that, in estimating a regulated rate of return and its input parameters, an efficient benchmark entity is closely based on a sample of similar firms operating in the energy industry in Australia and/or relevant evidence/information from the Australian financial market. As such, typical risks incurred by the sector are generally captured.

[192] Dampier to Bunbury Natural Gas Pipeline (DBNGP), WA Transmission Pty Ltd, “Submission on the Rate of Return Guidelines Consultation Paper”, 6 March 2013.

8.4.3 Evaluation

469. In previous sections and Appendix 9, the Authority has outlined the key characteristics of each approach/technique which has been proposed to determine a benchmark credit rating. Current Australian practice indicates that a median credit rating from a benchmark sample of Australian utility businesses is the most relevant approach for the purpose. The AER came to the same conclusion in its 2009 WACC Review. The Authority is not aware of any new method which has been proposed and considered by Australian regulators.

470. The Authority remains of the view that a median credit rating from a benchmark sample is currently the most relevant approach to determine a benchmark credit rating. However, the Authority also considers that further research is required to ensure that the determination of the benchmark credit rating for Australian regulated businesses is more robust.

8.4.3.1 Selection of companies for the benchmark sample

471. As previously discussed, the Authority considers that it is appropriate to include selected Australian companies subject to similar risk in the benchmark sample which is used to determine a benchmark credit rating. The selected companies are required to satisfy two criteria. *First*, a company must be a network service provider in the gas and/or electricity industry in Australia. *Second*, its credit rating must be based on an international rating agency such as Standard and Poor’s or Moody’s and be publicly available.

472. The Authority considers that the S&P list of Australian utilities is an appropriate starting point for a sample to determine a benchmark credit rating for the purpose of this rate of return guideline. The Authority has also conducted extensive research from other service providers such as Bloomberg and Moody’s to identity additional companies, which satisfy the above-mentioned criteria, for inclusion in the benchmark sample. The Authority’s findings indicate that both Bloomberg and Moody’s do not provide any additional firms in comparison with S&P’s list of Australian utilities. As such, the Authority is of the view that S&P’s list of Australian utilities is appropriate to be considered as the starting point for a benchmark sample to be determined.

473. The Authority is not aware of any new methods which can be used to determine a benchmark credit rating. The Authority is open to consider all new methods proposed.

8.4.3.2 Entity credit rating versus instrument credit rating

474. The Authority notes that credit ratings for instruments may be uplifted due to credit wrapping even though this practice is no longer common in Australia. The Authority is of the view that an entity’s credit rating will provide a more fundamental risk profile for a business. As such, this type of credit rating is preferred for deriving a benchmark credit rating.

475. However, in circumstances where no entity credit rating is available for a particular business whereas its instruments are rated, it is appropriate to include the instruments’ credit rating into the benchmark sample to ensure the benchmark sample includes sufficient data points for determining a benchmark credit rating.

8.4.3.3 Data

476. The Authority considers that there is no precedent in terms of how far historical data can be traced back. It is generally accepted historical data over a longer period may provide a better statistical estimate of the input WACC parameters. However, over a longer historical period there may have been structural breaks in the economy and as such, some data is no longer relevant to serve as a proxy for the present.

477. The Authority is of the view that, as long as there is sufficient data to conduct an empirical study/estimate, a period of 5 years is preferred because it is consistent with a regulatory control period.

8.4.3.4 Cross-checks

478. The Authority is of the view that some cross-check is required to ensure that a median credit rating derived from a benchmark sample is appropriate. Some financial indicators such as the S&P's and Moody's credit metrics can be employed for this purpose. However, the Authority also notes that international rating agencies such as S&P and Moody's have also placed significant attention on a qualitative assessment of a business when determining an appropriate credit rating. As such, complete analysis of a benchmark credit rating may not be available from the credit metrics.

8.5 Draft Guidelines

479. The Authority considers that a median credit rating approach based on a benchmark sample of Australian utilities subject to similar risk is currently appropriate and fit for purpose for determining the benchmark credit rating.

480. Companies included in the benchmark sample must satisfy two criteria. *First*, the company must be a network service provider in the gas and/or electricity industry in Australia. *Second*, its credit rating must be based on an international rating agency such as Standard and Poor's or Moody's and publicly available.

481. The Authority's recent analysis indicates that gas businesses face marginally higher risks in comparison with electricity businesses in Australia. The Authority's analysis also shows that the credit rating for Australian gas businesses is within the BBB-/BBB/BBB+ band. However, the Authority is of the view that research is required to ensure that the determination of the benchmark credit rating for Australian regulated businesses is more robust.

9 Debt risk premium

482. The generally accepted approach to estimating the return on debt involves estimating a debt risk premium, which is added to the estimate of the risk free rate. Key components in estimating the return on debt include:

- the credit rating of the benchmark service provider;
- the resulting debt risk premium of the benchmark service provider; and
- debt raising costs.

483. Australian economic regulators have consistently adopted this method for determining the cost of debt. However, an alternative approach – adopted by overseas regulators such as Ofgem and the New Zealand Commerce Commission (**NZCC**) – is to estimate the cost of debt directly from a sample of corporate bonds (without separately identifying the risk-free rate or debt risk premium).

484. The focus of this Chapter is on the estimate of the debt risk premium. The debt risk premium (also referred to as the debt margin) is a margin above the risk free rate of return reflecting the risk in providing debt finance. However, it is noted that estimates of the debt risk premium and the cost of debt share many similarities and no clear distinction can be found between the two processes. As such, the terms “estimate of the debt risk premium” and “estimate of the cost of debt” are used interchangeably in this chapter.

9.1 Current Approaches to Estimate the Cost of Debt

9.1.1 The Authority’s Current approach: A Bond-yield approach

9.1.1.1 Theoretical considerations

485. The debt risk premium provides compensation to lenders for the additional risk associated with providing debt capital, over and above the risk-free rate. As such, the extent of the compensation, or ‘credit spread’, is closely related to the risk of the business.

486. The debt risk premium for the benchmark firm is estimated by observing the credit spread on bonds with equivalent credit ratings to that of the benchmark firm. Observed yields on existing bonds in the market are the best proxy for the cost of debt incurred if debt is raised on the same day. A benchmark sample of corporate bonds is expected to capture the characteristics of the benchmark firm because they have the same credit rating assigned by an international rating agency such as S&P.

487. The Authority has considered the average term to maturity of the relevant bonds included in the benchmark sample. The Authority notes that the term to maturity is approximately 5 years which is also the term of the regulatory control period. The term of the cost of debt and the regulatory control period should be closely matched so that regulated businesses will not be over or undercompensated. This view is supported by academic literature in relation to the “NPV = 0” principle which was discussed at length in chapter 3.

9.1.1.2 The Bond-yield approach

488. Since 2010, the Authority has adopted the Bond-yield approach to estimate the debt risk premium in its regulatory decisions. The key component of this approach is to develop a benchmark sample in which a debt risk premium is derived. The following criteria are required to select bonds to be included in the benchmark sample.[193]

- credit rating of BBB/BBB+ by Standard & Poor's;
- time to maturity of 2 years or longer;
- bonds issued in Australia by Australian entities and denominated in Australian dollars;
- inclusion of both fixed bonds and floating bonds; and
- inclusion of both Bullet and Callable/ Putable redemptions.

489. The debt risk premium is derived based on the observed yields obtained from the bonds in the benchmark sample. A joint-weighted mechanism was adopted taking into account two key characteristics of bonds in the benchmark sample: (i) the term to maturity (a bond with a longer term to maturity is given a higher weight in the sample); and (ii) the amount at issuance (a bond with a larger amount at issuance is given a higher weight in the sample).[194]

9.1.2 Other alternative approaches adopted by regulators

490. Australian regulatory practices in relation to the estimate of the debt risk premium are presented in Table 10 below.

[193] Economic Regulation Authority, *Discussion Paper – Measuring the Debt Risk Premium: A Bond-Yield Approach*, December 2010 p.11.

[194] Australian Competition Tribunal, *Application by WA Gas Networks Pty Ltd (No3) [2012],* p. 42.

Table 10 Estimating the Debt Risk Premium in the Australian regulatory decisions

Regulator	Year	Industry	Cost of Debt Methodology
ACCC[195]	2011	Fixed Line Services (Telecommunications)	Observed 20 day average of DRP for a single Telstra bond maturing July 2020
AER[196]	2012	Gas Distribution Network	Extrapolation via Bloomberg's fair value curves
ERA[197]	2012	Electricity Distribution/Transmission	Bond Yield Approach
ERA[198]	2011	Gas Transmission	Bond Yield Approach
IPART[199]	2012	Water, sewerage, stormwater drainage and other services	Bloomberg Fair Value Curve and sample of securities – Inter-quartile range approach.
QCA[200]	2012	Water, sewerage, stormwater drainage and other services	Debt Risk Premium + Credit Default Swap allowance
ESCOSA[201]	2012	Water, sewerage, stormwater drainage and other services	Extrapolation via Bloomberg's fair value curves

Source: Compiled by the Economic Regulation Authority

491. In its inquiry into the access arrangements for fixed line services, the ACCC[202] used a single Telstra bond with a maturity of approximately 10 years to estimate the debt risk premium. The ACCC considered this bond to be representative of the cost of debt for providers of fixed line services. The ACCC estimated the debt risk premium by taking the 20-day average of the Telstra bond maturing on 15 July 2020[203] for the period from the 3rd to 30th June 2011. The estimated debt risk premium is the difference between this average of the observed yield and the Bloomberg's estimate of the 10 year CGS fair value curve (**FVC**).[204]

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195 Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 69.

196 Australian Energy Regulator, *Access Arrangement final decision Envestra Ltd 2013-17 Part 1,* March 2013, p. 30.

197 Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

198 Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p. 158.

199 Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p. 206.

200 Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 497.

201 Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p. 9.

202 Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 69.

203 Bloomberg Ticker: EI291758 Corp.

204 Bloomberg ticker: C12710Y Index.

492. The AER[205] and ESCOSA[206] have both utilised the Bloomberg FVC for estimating the debt risk premium in their regulatory decisions. The AER determined the debt risk premium by defining the benchmark bond as a 10 year corporate bond with a BBB+ credit rating. The debt risk premium is then measured by extrapolating the Bloomberg 7-year BBB fair value curve. The AER extrapolated the Bloomberg 7-year BBB FVC to a 10-year maturity using 'paired bond' analysis. This involves estimating the debt risk premium from the Bloomberg 7-year BBB FVC, then adding a premium estimated from the difference between the 10-year AAA FVC and the 7-Year AAA FVC:

10-year BBB FVC = 7-year BBB FVC + (10-year AAA FVC – 7-year AAA FVC)

493. ESCOSA also used the Bloomberg 7-year FVC as a starting point to estimate the debt risk premium. However, ESCOSA added an additional 20bp in order to extrapolate the estimate from a 7-year term to a 10-year term. This was based on an estimate of the difference in yields between the debt risk premium for bonds with a maturity greater than 7 years and the Bloomberg 7-year BBB FVC.

494. IPART utilised an inter-quartile range approach to estimating the debt risk premium by considering a sample of securities that serve as proxies for the cost of debt for Sydney's Water Corporation.[207] The Inter-quartile range approach defines the upper bound of the debt risk premium as being in the top 25 per cent of debt risk premiums in the sample, and the lower bound as being in the bottom 25 per cent of debt risk premiums in the sample. The midpoint of this range is then used as the debt risk premium estimate. The sample used by IPART in its review of prices for Sydney Water consisted of the Bloomberg 7-year BBB FVC, 13 Australian-issued bonds and 12 bonds issued by Australian companies denominated in USD.

495. In its determination for Sun Water, the Queensland Competition Authority (**QCA**) estimated the debt risk premium as the sum of the credit spread above the 5-year risk free rate for BBB+ rated bonds.[208] This debt risk premium was estimated by NERA. In addition, QCA included a credit default swap allowance of 0.25 per cent and an interest rate swap allowance of 0.19 per cent. It is noted that, in this determination, the cost of debt estimate exceeded the cost of equity estimate. QCA noted that this arises as a consequence of the debt risk premium being based on the promised yield, rather than the actual expected rate of return. The expected return would include a discount for the expected default losses of bonds.

496. Overseas regulators such as NZCC have also adopted a similar approach to the ERA's bond-yield approach.209 In NZCC's method, the debt risk premium is calculated as the spread between corporate bonds and NZ government bonds. The bid yields to maturity for NZ corporate bonds, issued by an electricity or gas distribution business, denominated in NZ dollars, publicly traded, and with a

[205] Australian Energy Regulator, *Access Arrangement final decision Envestra Ltd 2013-17 Part 1,* March 2013, p. 30.

[206] Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p.9

[207] Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p. 206.

[208] Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 497.

[209] Commerce Commission New Zealand 2012, *Cost of Capital Determination for Electricity Distribution Businesses to Apply to a Customised Price-Quality Path Proposal*, 2012 NZCC 25, September.

remaining maturity of five years, are used. With regard to the NZ government bonds, bid yields are contemporaneously interpolated for the remaining term to maturity of 5 years.

497. In the UK, Ofgem has used the real cost of debt calculated directly from iBoxx data, a fixed income benchmark indices, which is deflated using the Bank of England's 10 year break even inflation index. The iBoxx indices consist of an average of the non-financial sector's broad A and BBB rated corporate bonds.

498. The Alberta Utilities Commission determines the cost of equity independently of the cost of debt. The debt risk premium plays an indirect role through qualitative adjustments made to the return on equity with respect to returns available on high grade corporate bonds.[210]

9.2 Submissions

499. A number of submissions responded to the issues raised in the Authority's Rate of Return Consultation Paper in relation to the debt risk premium.

9.2.1 Multiple approaches to estimate the cost of debt

500. A number of stakeholders considered that the NGR explicitly provide for more than one approach to estimating the return on debt. In this context, the debt risk premium does not need to be estimated explicitly.[211]

501. For example, APIA included material from the Brattle Group, which set out a range of methods for estimating the return on debt. The submission considered that these proposed approaches take into account economy-wide and company-specific factors and they are consistent with the allowed rate of return objective.[212]

502. The Brattle Group argued that, unlike the cost of equity, the cost of debt varies with both systematic and idiosyncratic risks. That is, the cost of debt is determined by both systematic factors and company-specific characteristics. The Brattle group submitted that, as a consequence, there is a broader set of factors which impact on the estimate of the cost of debt than the cost of equity. In addition, the Brattle Group noted that most methods used to estimate the cost of debt are based on empirical data and, as such, they are not mutually exclusive.

503. *The first approach* outlined by the Brattle Group is an average of the observed yield on a sample of comparator companies. The Brattle Group agreed that determining a sample of comparator companies is not a straightforward exercise. They argued that selecting a bond or index based on credit rating is inappropriate

210 Alberta Utilities Commission 2011, *2011 Generic Cost of Capital, Decision 2011-474*, December, p. 24.

211 ATCO Gas Australia, "Response to ERA consultation paper on rate of return guidelines", 28 February 2013.

Energy Networks Association, Response to the AER Rate of Return Guidelines- Issues Paper , February 2013. p. 27.

Australian Pipeline Industry Association, *Response to Issues Paper: The Australian Energy Regulator's Development of Rate of Return Guidelines*, February 2013, p.43.

Goldfield Gas Pipeline, *Submission to Economic Regulation Authority Consultation Paper: guidelines for the Rate of Return for Gas Transmission and Distribution Networks*, February, 2013. pp. 20-25.

Dampier to Bunbury Natural Gas Pipeline, *Submission: Rate of Return Guidelines Consultation Paper, March 2013*, pp.19-20.

212 The Brattle Group, "Estimating the Cost of Debt", 4 March 2013. p. 3.

because this does not differentiate firms based on financial indicators such as coverage ratios, capital structures, cash flow variability and fundamental demand/supply conditions.

504. The Brattle Group argued that these factors will impact the cost of debt of a regulated business. As a consequence, they suggested that only comparable companies which have similar business and financial risks should be used to estimate the benchmark firms cost of debt. The Brattle Group also submitted that it may be necessary for the regulator to adjust any comparable company to better replicate the benchmark efficient firm. However, they did not propose any mechanism for doing so.

505. *The second approach* suggested by the Brattle Group is to decompose the estimated cost of debt into the following two components:

Cost of Debt = Risk Free Rate + Debt Risk Premium

506. The Brattle Group submitted that this approach implies the use of the average spread of utility bond yields over that of the government bond yields over a historic period. They noted that this approach implicitly assumes that the utility bond yields are consistent with the cost of debt of a benchmark efficient entity with a similar risk. The Brattle group argued that the approach of using current risk-free rate and a historical estimate of the debt risk premium is problematic.

507. *The third approach* proposed by the Brattle Group is to estimate the embedded cost of debt. This approach aims to replicate the actual interest expenses incurred by the regulated entity. The Brattle Group noted that it may be feasible to estimate the embedded cost of debt by using a number of comparable entities with similar risk to the benchmark efficient entity.

508. The Brattle Group argued that this approach has the advantage of allowing a regulated entity to recover its actual costs of debt. In its report, the Brattle Group also presented world-wide evidence that suggested that the embedded cost of debt is higher than that of the relevant utility bond index. They noted that this is due to the decline in interest rates over the recent decade.[213] The Brattle Group also noted that if interest rates increase, the embedded cost of debt will likely be lower than that of the utility bond index. The Brattle Group also noted that that the embedded cost of debt varies substantially across the surveyed entities. [214]

509. Some stakeholders considered that the NGR allowed for stakeholders to choose a range of different approaches to estimating the debt risk premium, including the on-the-day, trailing average, and hybrid approaches.[215] These issues were considered in detail in Chapter 3.

[213] The Brattle Group, “Estimating the Cost of Debt”, 4 March 2013.

[214] Ibid.

[215] ATCO Gas Australia, “Response to ERA consultation paper on rate of return guidelines”, 28 February 2013.

[215] Energy Networks Association, “Response to the AER Rate of Return Guidelines – Issue Paper”, February 2013.

[215] DBP, *Response to the ERA’s Consultation Paper: Guidelines for the Rate of return of Gas Transmission and Distribution Networks,* 17 Feb 2013.

9.2.2 Bloomberg's estimates of the Fair Value Curves

510. Submissions also questioned why the Authority was not considering Bloomberg's Fair Value Curve for estimating the DRP.[216]

9.2.3 Yield Curve Fitting

511. WATC submitted that the Authority has stopped using the Bloomberg's Fair Value curves to estimate the DRP in favour of the bond-yield approach. WATC also submitted that they are in favour of fitting a yield curve to bond yield data for a given credit category. WATC argued that this curve-fitting approach would allow an estimate of the DRP conditional on the maturity of a bond, which the WATC argued that the bond yield approach does not facilitate. WATC noted there is a large literature on constructing a yield curve. WATC submitted that their preferred methodology of fitting a risk-free yield curve using the "maximum smoothness" forward rate procedure. In this procedure, WATC submitted that the credit spreads for each bond in the benchmark sample relative to the risk free are calculated. This credit spread data is then fitted into a yield curve using the maximum smoothness forward rate procedure. WATC noted this approach was recommended by Professor Erik Schogl to IPART.[217] WATC also noted that if extrapolation of bond yields is required, (i.e. the bond with the longest term to maturity in the sample is shorter than the regulatory control period) then the regression model described by Queensland Treasury Corporation should be used.[218]

9.2.4 The Authority's Bond-yield approach

512. Stakeholders questioned whether the Authority's bond yield approach meets the requirements of the NGR. Other stakeholders suggested that the bond yield approach needed to be amended to meet the requirements of the NGR.[219]

9.2.5 Specific Adjustments to the Cost of Debt

513. In its submission, the Brattle Group argued that the credit rating should not be considered in isolation. It submitted that specific financial ratios and risk factors should be taken into account when determining the cost of debt for a particular regulated business.

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[216] Goldfields Gas Transmission Pty Ltd, "*Submission to Economic Regulation Authority Consultation Paper: Guidelines for the Rate of Return for Gas Transmission and Distribution Networks."* 28 February 2013 p. 19.

Western Australian Treasury Corporation, "Rate of Return Guidelines Review", 15 March 2013.

[217] Schogl, E 2009, "Estimation of the interest rate term structure of corporate debt", Appendix A in IPART 2009, "Estimating the debt margin for the weighted average cost of capital. Analysis and Policy Development-Discussion Paper", May 2009.

[218] Queensland Treasury Corporation, "Debt Risk Premium Analysis," Appendix C in *Powerlink Queensland 2013-2017 Revised Revenue Proposal,* January 2012.

[219] DBP, *Response to the ERA's Consultation Paper: Guidelines for the Rate of return of Gas Transmission and Distribution Networks,* 17 Feb 2013.

[219] Western Australian Treasury Corporation, "Rate of Return Guidelines Review", 15 March 2013.

[219] Goldfields Gas Transmission Pty Ltd, "*Submission to Economic Regulation Authority Consultation Paper: Guidelines for the Rate of Return for Gas Transmission and Distribution Networks."* 28 February 2013.

9.3 Considerations of the Authority

514. The Authority considers that the bond yield approach continues to offer the best means to estimate the debt risk premium. In what follows, the Authority considers the points raised in submissions in relation to the bond yield approach, and also the merits of the alternative approaches.

9.3.1 Multiple approaches to estimate the cost of debt

515. ATCO Gas submitted it was concerned that the Consultation paper appeared to only be advocating the use of the bond yield approach and that the NGR does not restrict the regulator to the use of a single financial model and moreover, requires the use of alternative financial models.

516. The Authority considers that it has not restricted itself to the use of a single financial model. The objective is that regulatory decisions are made that are consistent with the allowed rate of return, irrespective of the number of models used.

517. The Consultation Paper discussed issues in relation to the estimate of the debt risk premium which involved the ACT's decisions and the Authority's existing methodology. The purpose for doing so was to promote further consideration of the issues.

518. On this basis, the Authority is open to considering all relevant methods which can be used to determine the debt risk premium for the return on debt. The Authority is of the view that alternative models and methodologies must be considered on the basis of the allowed rate of return objective:

- financing costs must be efficient;
- the estimated cost of debt must be commensurate with the benchmark efficient entity; and
- risk must be of a similar degree as that of the reference service provider.

519. The Authority notes that the bond yield approach does take account of the risks for the benchmark efficient entity. As noted in chapter 4, debt holders may diversify their risk. The remaining risk will be reflected in the debt risk premium.

9.3.2 Bloomberg's Estimates of the Fair Value Curves

520. The Authority notes that its reasons for a departure from the use of Bloomberg's FVC were discussed at length in its Discussion Paper[220] and the Final Decisions on WAGN's proposed Access Arrangement.[221]

521. The Authority considers that a major concern was the lack of liquidity in the Australian corporate bond markets and that Bloomberg's estimates of the FVC

[220] Economic Regulation Authority, *Discussion Paper – Measuring the Debt Risk Premium: A Bond-Yield Approach,* December 2010*.*

[221] Economic Regulation Authority, Final Decision on Proposed Revisions to the Access Arrangement for the Mid West and South-West Gas Distribution System, Feb 2011.

Independent Pricing and Regulatory Tribunal, *Estimating the debt margin for the weighted average cost of capital, Analysis and Policy Development* – Discussion Paper May 2009, p20.

have been substantially different from those observed in the Australian corporate bond markets. The Authority considers that the difference could potentially be a result of the Bloomberg methodology to extrapolate from the observed yields of shorter term-to-maturity bonds into the longer term FVC.

522. As previously discussed in the Discussion Paper, the method used by Bloomberg is not disclosed to the public and therefore the Authority could not determine the drivers of the difference. In addition, the approach is not replicable. As a consequence, the Authority is of the view that the bond-yield approach is a better reflection of the cost of debt for an efficient benchmark entity than the Bloomberg estimates of the FVC.

9.3.3 Yield Curve Fitting

523. WATC submitted that it is in favour of fitting a yield curve to observed bond yield data for a given credit band. It considered that this approach would allow a DRP estimate conditional on the maturity of a bond.

524. WATC also highlighted that there is a large volume of literature on constructing yield-curves and WATC submitted its preferred methodology of fitting a risk-free yield curve using the "maximum smoothness" forward rate procedure. WATC also submitted that this procedure was recommended to IPART by Professor Erik Schlogl.

525. The Authority notes that Professor Erik Schlogl's advice to IPART was provided in order to ascertain if it is possible to extrapolate the debt risk premium for longer term maturities than that currently observed for Australian corporate bonds.[222] This request was due to the 10-year term previously adopted by IPART in its WACC estimate being longer than the observed terms of relevant bonds in the Australian corporate debt market. It is noted that IPART has now adopted the 5-year term for estimates of the risk-free rate and the cost of debt.

526. The Authority currently adopts a 5-year term for estimating the debt risk premium and the risk-free rate. As such, extrapolation using this methodology is unnecessary. In particular, the Authority notes that Professor Schlogl suggested applying the Krishnan, Ritchken and Thomson (2008) methodology to Australia.[223] Professor Schlogl suggested using international debt risk premiums for comparable bonds to mitigate the lack of Australian corporate bonds.

527. The Authority disagrees with the use of international data in constructing the bond sample for Australia within the domestic WACC framework. The Authority considers however that the application of the Nelson-Siegel yield curve may have merit. By utilising the sample of bonds adopted in the bond-yield approach in its previous regulatory decisions, a Nelson-Siegel yield curve can be fitted which would allow a debt risk premium to be estimated conditional on a 5-year maturity.

528. The Nelson-Siegel methodology assumes that the term structure of the debt risk premium has the following parametric form:

[222] Independent Pricing and Regulatory Tribunal, *Estimating the debt margin for the weighted average cost of capital, Analysis and Policy Development* – Discussion Paper May 2009, p20.

[223] Krishnan, C. N.V, Ritchken, P.H. and Thmonson, J.B. (2010), 'Predicting Credit Spreads', *Journal of Financial Intermediation,* Vol 19, p529-563.

$$y_t(\tau) = \beta_{0t} + \beta_{1t}\frac{1-\exp(-\lambda\tau)}{\lambda\tau} + \beta_{2t}\left(\frac{1-\exp(-\lambda\tau)}{\lambda\tau} - \exp(-\lambda\tau)\right) \tag{9}$$

where

$y_t(\tau)$ is the credit spread (debt risk premium) at time t for maturity τ ; and

$\beta_{0t}, \beta_{1t}, \beta_{2t}, \lambda$ are the parameters of the model to be estimated from the data.

529. The Nelson-Siegel methodology uses observed data from the bond market to estimate the parameters $\beta_{0t}, \beta_{1t}, \beta_{2t}, \lambda$ by using the observed debt risk premium and maturities for bonds. With the estimated parameters $\widehat{\beta_{0t}}, \widehat{\beta_{1t}}, \widehat{\beta_{2t}}, \hat{\lambda}$, a yield curve is produced by substituting these estimates into (1) and plotting the resulting *estimated* debt risk premium $\widehat{y_t(\tau)}$ by varying the maturity τ . $\widehat{y_t(\tau)}$ has the interpretation of being the *estimated* debt risk premium for a benchmark bond with a maturity of τ for a given credit rating.

530. The Authority has applied this methodology to the bonds underlying the bond-yield approach in recent regulatory decisions. The parameters $\beta_{0t}, \beta_{1t}, \beta_{2t}, \lambda$ were estimated using the R functions *Nelson.Siegel* in the Yield Curve package.[224] Given the underlying bonds representing a given credit rating band (BBB/BBB+ in this case), this estimated curve has the interpretation of being the term structure of the debt risk premium for a given credit rating.

531. The estimated debt risk premiums from previous decisions using the joint-weighted mechanism and the Nelson-Siegel yield curve fitting are presented in Table 11 below.

Table 11 Estimates of the Debt Risk Premium from the Bond-yield Approach and the Nelson-Siegel Curve Fitting

Decision	Date	Joint-Weighted DRP[225]	Nelson-Siegel DRP	$\widehat{\beta_{0t}}$	$\widehat{\beta_{1t}}$	$\widehat{\beta_{2t}}$	$\hat{\lambda}$
DBP[226]	31/10/2011	3.196%	3.34%	0.0197	0.334	10.60	0.0285
WAGN[227]	20/12/2010	2.893%	2.83%	0.022	-0.347	10.913	0.2266
Western Power[228]	15/06/2012	2.708%	2.82%	2.343	-6.115	8.707	0.0725

Source: Economic Regulation Authority's analysis

532. Table 11 , the Authority notes that the estimates of the debt risk premium can be higher (as in the case for WAGN) and lower (as in the case for DBP and Western

224 *Full documentation available at : http://cran.r-project.org/web/packages/YieldCurve/YieldCurve.pdf.*

225 Note that the Joint-weighted approach was developed post 2012, this is a retrospective calculation for comparison purposes.

226 Economic Regulation Authority, October 2011, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline.*

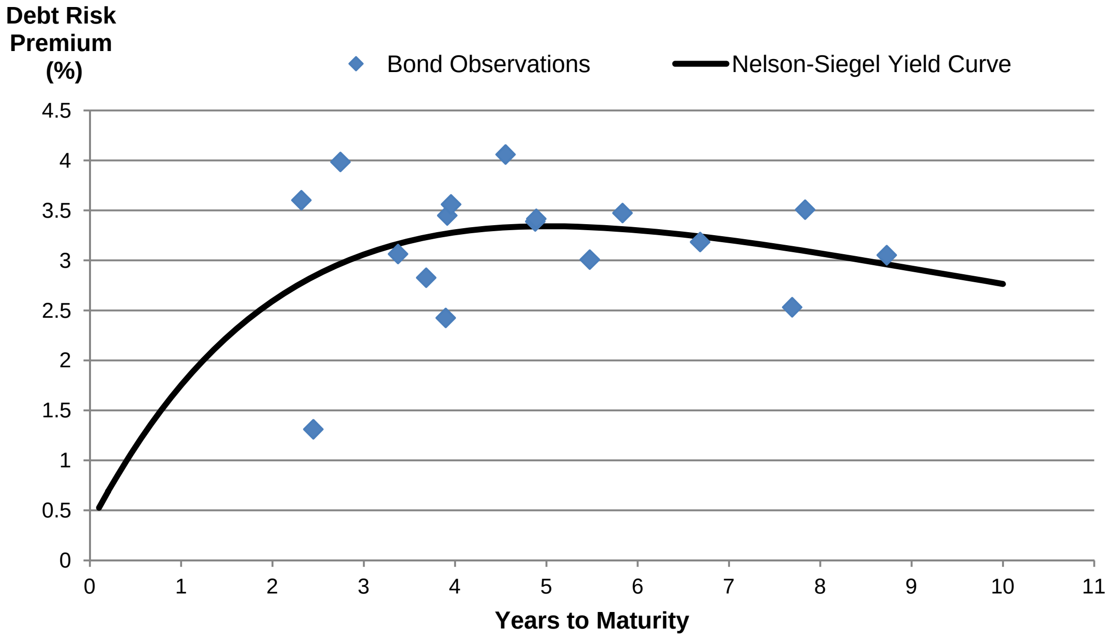
227 Economic Regulation Authority, December 2010, *Final Decision on Proposed Revisions to the Western Australian Gas Network.*

228 Economic Regulation Authority, *Final Decision on Proposed Revisions to the access arrangement for Western Power, 2012*

Power). The difference of the estimates under both approaches varies within the range of 6 and 14 basis points. However, the Authority is conscious whether or not the difference (both under- and over-estimates) is significant enough to warrant such an extension of using the curve fitting techniques. Using the estimates from the Authority's three most recently regulatory decisions as an example, the difference of the estimates under both approaches fall within a very small margin of less than 5 per cent in comparison with the estimate debt risk premium. For example, for DBNGP's decision, the debt risk premium is 3.196 per cent whereas the difference between the two approaches is 14 basis points (or 0.14 per cent). This difference falls within a margin of 4.3 per cent (taking 0.14 per cent divided by 3.196 per cent).

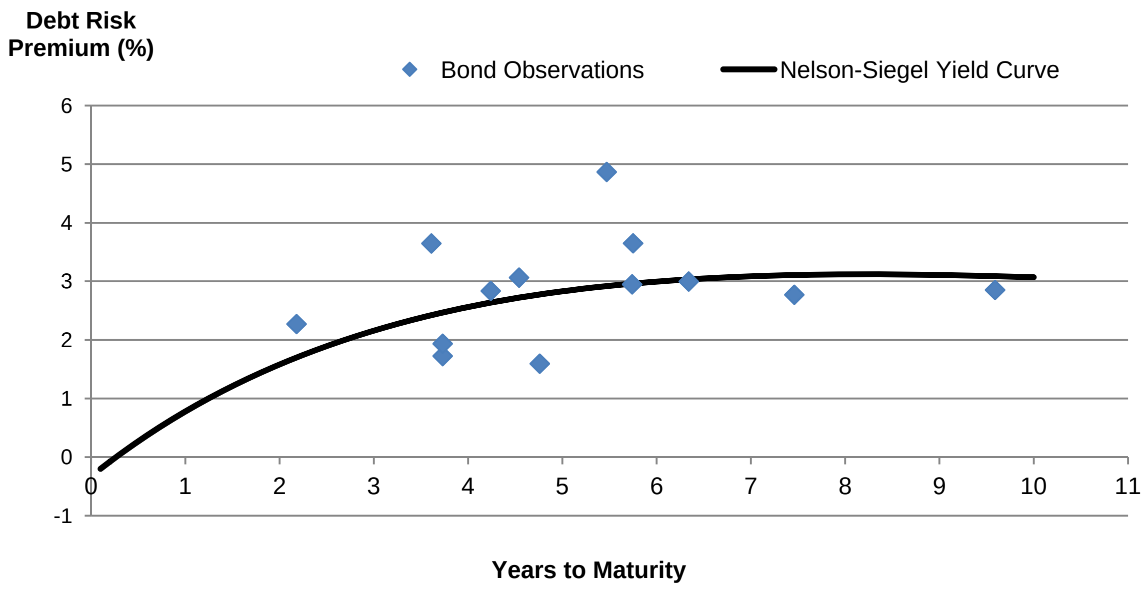
533. Curve fitting is a complex issue and there are various different techniques which can be used. The Authority considers that the small benefit from this complex technique is not sufficient to outweigh the costs involved in carrying out the exercise.

Figure 11 Nelson-Siegel Yield Curve Fitting using Data from DBNGP Final Decision



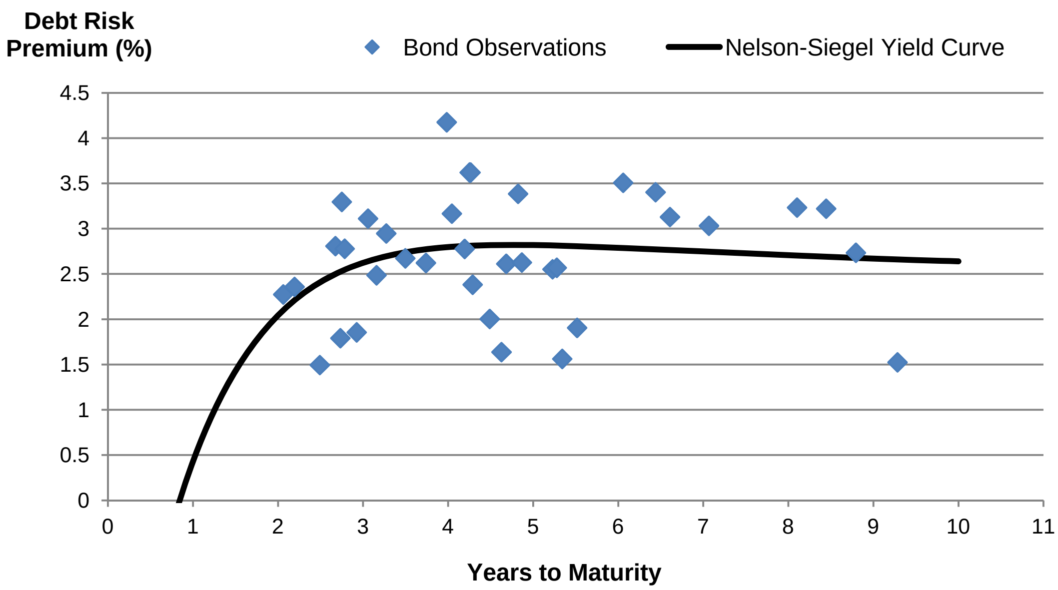
Source: Economic Regulation Authority's analysis

Figure 12 Nelson-Siegel Yield Curve Fitting using Data from WAGN Final Decision



Source: Economic Regulation Authority's analysis

Figure 13 Nelson-Siegel Yield Curve Fitting using Data from Western Power Final Decision



Source: Economic Regulation Authority's analysis

9.3.4 The bond-yield approach

534. WATC submitted that they were concerned with the benchmark sample used in the bond-yield approach in terms of (i) input data quality; and (ii) selection criteria.[229]

[229] Western Australian Treasury Corporation, "Rate of Return Guidelines Review", 15 March 2013.

535. *First*, with respect to input data quality, the following issues were raised in the WATC's submission:

- some bonds used in determining the debt risk premium for Western Power's third Access Arrangement had less than 20 days of data;
- some of the data had low Bloomberg's valuation scores; and
- a larger sample of bonds was available through the UBS database.

536. The Authority's current practice is to include bonds with observed yields available during the "pricing period" of 20-trading days. Bonds which satisfy all selection criteria for inclusion in the benchmark sample and which have 50 per cent data points or more (i.e. observed yields available in 10 days or more out of the entire pricing period of 20 days) will be retained in the benchmark sample. Bonds, which satisfy all selection criteria for inclusion in the benchmark sample and which have 9 data points (observed yields) and below will be excluded from the final benchmark sample. The Authority is of the view doing so will maximise the number of bonds available in the benchmark sample.

537. The Authority is aware of the potential weaknesses of observed yields for some bonds reported by Bloomberg. However, as discussed at length in its Discussion Paper released in December 2010[230] and its final decision on the adoption of the bond-yield approach in estimating the debt risk premium in WAGN's proposed Access Arrangement,[231] the Authority is of the view that there is a trade-off between the relevance of the market data and the number of observations in the benchmark sample. The Authority notes that using Bloomberg's high valuation scores on observed yields will reduce the size of the benchmark sample to only a few bonds.

538. The Authority does not have access to the UBS's database and is not aware of such access being made available to economic regulators. Given Bloomberg's reputation as the world's leading service provider of financial data, the Authority considers that it is appropriate to use Bloomberg's reported data on Australian corporate bonds with their relevant observed yields data.

539. *Second*, in relation to the selection criteria to determine the benchmark sample, in its submission, WATC proposed the following bonds should be excluded from the sample:

- bonds with issuance less than $100 million;
- bonds with implicit government guarantees;
- bonds with rating dependent step-up clauses;
- bonds attached to public private partnership infrastructure;
- floating rate notes;
- convertible bonds;
- bonds issues in offshore markets; and
- bonds with imbedded options.

230 Economic Regulation Authority, *Discussion Paper – Measuring the Debt Risk Premium: A Bond-Yield Approach,* December 2010.

231 Economic Regulation Authority, December 2010, *Final Decision on Proposed Revisions to the Western Australian Gas Network.*

540. As previously discussed, the Authority considers that it is appropriate to recognise a trade-off between the relevance of the data and the number of observations. The Authority is of the view that the objective is to estimate a debt risk premium that is representative of a 'normal' or "benchmark" rate of return on debt an investor would earn on an asset with similar risk.

541. The Authority considers that determining the benchmark sample based on criteria that are too restrictive will result in a small sample of observations. This very small sample will lead to a decrease in statistical reliability and an increase in the risk of bias toward the individual characteristics of particular bonds in the sample.

542. In response to WATC's proposed selection criteria, Table 12 below demonstrates the change in the estimate of the debt risk premium when bonds are excluded based on WATC's proposal in comparison with the initial benchmark sample developed in the Authority's bond-yield approach.

543. The Authority notes that the estimate of the debt risk premium slightly increases with a maximum magnitude of as low as 6 basis points in comparison with the original benchmark sample. The Authority also notes that the standard error for these estimates also increases representing an increased inefficiency of the estimates based on the sample with too many restrictions.

Table 12 The Authority's Bond-yield Approach (Sample 1) and WATC's Proposed Criteria (Sample 2), June 2013

Sample	Number of Bonds in Sample 1	Number of Bonds in Sample 2 After Criteria Applied	Mean of the Debt Risk Premium	Standard Error (SE) (bp)	SE as a per cent of Mean
Initial Sample	**25**		**2.050**	**0.058**	**2.82%**
Excluding Bonds with:					
Face Value < $100m	25	23	2.045	0.063	3.06%
Implicit Government Guarantee	25	18	2.113	0.065	3.08%
Rating Dependent Step Up Clauses	25	17	2.101	0.066	3.15%
PPP Infrastructure Issuer	0	0	-	-	-
Embedded Options	0	0	-	-	-
Convertible Feature	0	0	-	-	-
Issue in Offshore Market	0	0	-	-	-
Floating Rate	0	0	-	-	-
All of the above Criteria	25	15	2.101	0.075	3.56%

Source: The Economic Regulation Authority's analysis

9.3.5 Specific Adjustments to the Cost of Debt

544. The Brattle Group argued that the credit rating should not be considered in isolation. It submitted that specific financial ratios and risk factors should be taken into account when determining the cost of debt for a particular regulated business.[232]

545. The Authority considers that assigning a credit rating to a debt security of a business is an independent assessment by the independent rating agency. This

[232] The Brattle Group, "Estimating the Cost of Debt", 4 March 2013.

process considers both qualitative and quantitative statements reflecting the likely riskiness of holding a debt security. The Authority is of the view that bonds with the same credit rating appear to have a similar probability of default.

546. The Authority notes that credit rating agencies such as S&P's and Moody's explicitly take economy wide and company specific factors into account when assigning credit ratings to debt securities. For example, Standard and Poor's determines the credit rating by evaluating the business risk (qualitative assessment) and financial risk (quantitative assessment) faced by holders of debt securities. Table 13 presents the S&P's risk profile to determine the credit rating for a particular business.

Table 13 Standard and Poor's Risk Profile Matrix

Business and Financial Risk Profile Matrix						
Business Risk Profile	*Financial Risk Profile*					
	Minimal	**Modest**	**Intermediate**	**Significant**	**Aggressive**	**Highly Leveraged**
Excellent	AAA	AA	A	A-	BBB	-
Strong	AA	A	A-	BBB	BB	BB-
Satisfactory	A-	BBB+	BBB	BB+	BB-	B+
Fair	-	BBB-	BB+	BB	BB-	B
Weak	-	-	BB	BB-	B+	B-
Vulnerable	-	-	-	B+	B	CCC+

Source: S&P's

547. S&P states a more comprehensive list of categories on which it bases its assessment of financial risk which includes accounting; financial governance and policies/risk tolerance; cash flow adequacy; capital structure/asset protection; and liquidity/short-term factors. Furthermore, its assessment also incorporates business risk including country risk; industry risk; competitive position; and profitability/peer group comparisons.

548. As such, the Authority is of the view that using the credit rating as the main measure of risk faced by holders of the debt securities of an efficient benchmark firm is appropriate. The Authority therefore considers that the credit rating is the most appropriate measure for determining the efficient financing costs incurred by a benchmark efficient entity with a similar degree of risk. The Authority disagrees with the Brattle Group's submission that the regulator should explicitly perform an adjustment so that the business and financial risk of the benchmark efficient firm is better matched with that of a regulated business.

9.3.6 Evaluation

549. The Authority notes that, in Australia, the bond-yield approach (or its deviations) or the Bloomberg FVC are generally used to estimate the cost of debt in regulatory decisions. In its Discussion Paper released in December 2010, the Authority discussed at length the reason to depart from the Bloomberg FVC. The Authority does not consider the Bloomberg FVCs are 'implemented in accordance with best practice', as they are not supported by 'robust, transparent and replicable' datasets.

550. The Authority has received proposals for possible alternative models to estimate the cost of debt from the Brattle Group. It is however noted that none of these

alternatives is feasible for adoption in the Australian regulatory context. The Brattle Group appears to agree with this view. As such, the Authority is of the view that the bond-yield approach is 'fit for the purpose' for estimating the return on debt.

551. The Authority notes that WATC raised various issues in relation to the application of the bond-yield approach. The Authority has addressed each of these issues and concluded that the bond-yield approach in its original form, after the ACT's ruling, is the most appropriate approach for estimating the cost of debt in this rate of return guideline.

552. The Authority has not received any further submissions on the joint-weighting mechanism except the view from DBP that there is no basis for the joint-weighting mechanism. The Authority is of the view that the joint-weighting mechanism was developed using a robust process and supported by financial theory. In addition, this mechanism is now endorsed by the ACT. As such, the Authority considers that the joint-weighting mechanism is 'fit for the purpose' of estimating the debt risk premium in this rate of return guidelines.

553. Overall, the Authority is of the view that the bond-yield approach and its joint-weighting mechanism are likely to best meet the allowed rate of return objective and requirements.

9.4 Draft Guidelines

554. The Authority is of the view that it is appropriate to use the bond-yield approach together with the joint-weighting mechanism to estimate the debt risk premium.

555. The debt risk premium derived from the bond-yield approach will be based on the observed yields of relevant Australian corporate bonds, taken from Bloomberg, that qualify for inclusion in the benchmark sample. In addition, the Authority notes that UBS provides pricing for floating rate notes which is included in the Authority's bond-yield approach. As such, for the purpose of this rate of return guidelines, USB pricing will be considered, together with Bloomberg, in the estimates of the debt risk premium.

556. The weighted average cost of debt from the benchmark sample will be derived using two key parameters of Australian corporate bonds: (i) the term to maturity; and (ii) the amount at issuance.

10 Return on equity

557. In estimating the rate of return (or the cost of debt) for the Australian regulated businesses, a reasonable rate of return on equity is significantly important. While there are proxies for the rate of return on debt which can be observed directly from the market, there is no good proxy for the rate of return on equity. The expected rate of return on equity is unobservable. As such, estimating a reasonable rate of return on equity is a very challenging task for the Australian economic regulators in their decisions.

558. The Australian regulatory and commercial practices indicate that the tool commonly used for quantifying the return on equity and associated risk has been the Capital Asset Pricing Model (**CAPM**). The CAPM explains the expected return on equity for any financial asset in terms of its specific risk premium, over and above the nominal risk free rate.

559. The CAPM estimates the risk premium associated with a particular asset by quantifying the relationship between the specific asset and the level of systematic (or non-diversifiable) risk.[233] The higher the level of non-diversifiable risk of the asset, the higher is the required or expected rate of return. The CAPM uses the asset beta to describe the non-diversifiable returns of a particular asset.

560. A range of models and approaches seek to estimate the return required by equity investors. Generally, these seek to explain the required rate of return in terms of a relationship with some ‘portfolio’ of risk factors, or else by estimating the value the expected stream of future cash flows.

561. In this chapter the Authority assesses the range of models and approaches against the requirements of the National Gas Rules. In particular, the Authority evaluates which models are ‘relevant’ for informing the return on equity. The Authority also considers whether it should utilise more than one model, and if so, how to combine estimates. In seeking to determine whether a model is relevant, the Authority draws on the criteria set out in Chapter 2 to inform its judgment.

10.1 Submissions

562. Most submissions were of the view that models of the cost of equity were imperfect because each model is unable to capture all risks faced by regulated businesses. These submissions supported the use of multiple models for estimating the return on equity, on the basis that this reduces any bias associated with the use of a single model.

563. The Australian Pipeline Industry Association (**APIA**) for example, provided supporting opinion from Brattle Group, who considered that ‘analysts have a host of potential models at their disposal, and that... cost of capital estimation continues to be part art’.[234] APIA consider, based on the Brattle Group advice, that the following methods are relevant to determining the cost of equity:

- Sharpe-Lintner CAPM;

[233] The systematic risk or non-diversifiable risk encompasses those risks faced by market as a whole, which cannot be reduced by diversification through a well constructed portfolio of assets. This is the market risk premium.

[234] Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Schedule 2, p. 39.

- Empirical CAPM;
- Consumption-based CAPM;
- Fama-French Three-factor Model;
- Arbitrage Pricing Theory;
- Dividend Discount Model (both single-stage and multi-stage);
- Residual Income Model;
- Risk Premium Approaches;
- Build-up Method;
- Comparable Earnings.

564. APIA also cite Brattle Group evaluation to suggest that the following methods are not relevant for determining the cost of equity:[235]

- Market-to-book and Earnings Multiples;
- Analyst Reports.

565. APIA suggested the following approach for taking account of multiple model estimates:[236]

- identify the set of relevant models and information;
- for each model, determine a range for the return on equity for the benchmark firm;
- use broad rules and judgement to reduce the multiple return on equity ranges for the benchmark firm into a single point estimate; and
- consider whether the estimate of the return on equity for the benchmark firm should be further adjusted to reflect the unique risks of the specific service provider.

566. APIA proposed that an explicit set of specified economic, industry and company factors should be used to weight the models and relevant information.[237]

567. The Energy Networks Association (**ENA**) on the other hand suggested an alternative four stage approach, as follows:[238]

- determine the set of relevant models and information;
- for each model, determine point estimates of the return on equity for the average firm, and use these to identify a single estimate for the return on equity for the average firm;
- for each model, determine point estimates of the return on equity for the benchmark firm; and
- use the multiple return on equity estimates to establish a single estimate for the return on equity of the benchmark firm.

[235] Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, p. 42.
[236] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, p. 17.
[237] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, p. 26.
[238] Energy Networks Association 2013, *ERA Consultation Paper – Rate of Return Guidelines*, Attachment, www.erawa.com.au, p. 24

568. In addition to voicing support for the use of multiple models:

- Goldfields Gas Transmission (**GGT**) expressed a range of concerns with regard to the Capital Asset Pricing Model. These included concerns relating to the estimate of the market risk premium, and its consistency with the risk free rate, citing work by Competition Economists Group – these concerns are addressed in chapter 11 - Market risk premium.[239]
- ATCO considered that questions relating to the detail of the parameters of the Sharpe-Lintner CAPM do not need to be considered in the Guidelines, as these will be considered in access arrangement revisions decisions.[240]
- Dampier Bunbury Pipeline (**DBP**) supported APIA's submission, including the requirement for an explicit set of weights. DBP considers that a final step should be to 'circle back' to consider a 'reasonableness check' as to whether the rate of return estimates are consistent with the allowed rate of return objective.[241]

569. Major Energy Users of Western Australia submitted that the Sharpe-Lintner CAPM has been used successfully by regulators in the past, but that it does have drawbacks, including that the return on equity has been volatile. However, Major Energy Users consider that there has to be a demonstrably better outcome from any new approach before it is adopted, which can only be assessed by comparing model outputs against real world outcomes.[242]

570. Wesfarmers Chemicals Energy & Fertilisers consider that in setting parameters under the Sharpe-Lintner CAPM, the Authority should consider the outputs of other models to inform qualitative assessments with reference to a comparator group.[243]

10.2 Considerations of the Authority

10.2.1 Models of the return on equity

571. The standard regulatory implementation of the Capital Asset Pricing Model (**CAPM**) is known as the Sharpe-Lintner CAPM, after two of the original authors.

572. Other asset pricing models in the CAPM family build on the standard Sharpe-Lintner CAPM, including:

- the Black and Empirical CAPM;
- the Consumption CAPM; and
- the Inter-temporal CAPM.

573. There is also a large range of other models which seek to estimate the return on equity, including:

[239] Goldfields Gas Transmission Pty Ltd 2013, *Submission to Economic Regulation Authority Consultation Paper*, www.erawa.com.au, p. 14.

[240] ATCO Gas Australia 2013, *Response to ERA consultation paper on rate of return guidelines*, www.erawa.com.au, p. 20.

[241] DBNGP (WA) Transmission Pty Ltd 2013, *Response to Consultation Paper*, www.erawa.com.au, p. 20.

[242] Major Energy Users of Western Australia 2013, *Submission*, www.erawa.com.au, p. 23.

[243] Wesfarmers Chemicals Energy & Fertilisers 2013, *Submission*, www.erawa.com.au, p. 3.

- Arbitrage Pricing Theory family of models;
- the Fama-French Three-Factor Model and its extensions;
- the Dividend Discount Model family (both single-stage and multi-stage);
- the Residual Income Model;
- Market Risk Premium approaches; and
- the Build-up Method.

574. In addition, there are approaches that are not based on modelling *per se*, but rather on available data from a range of comparators or analysts' reports. These include:

- estimated market returns on comparable businesses;
- brokers' reports and the Dividend Yield approach.

575. A summary of these alternative approaches for estimating the return on equity is set out in Appendix 11.

10.2.2 Theoretical considerations

576. The estimate of the rate of return on equity is developed ex ante, as this is consistent with the incentive regulation approach adopted by the Authority (see Chapter 2.

577. The starting point for measuring the return required by equity investors ex ante is the extent to which the underlying assets are expected to generate returns in the form of cash flow over the future period. This leads to a number of considerations.

578. First, the equity investor is principally concerned with the risks relating to that stream of future cash flows. If an investor could expect to achieve the same return elsewhere at lower risk, then it would be irrational to invest in the asset, as the expected present value ex ante would be lower than the alternative investment. Thus, the efficient rate of return should just compensate the investor for the additional risk of holding the asset, over and above the 'risk free' asset. This is the key insight of the Markowitz's portfolio theory and its derivative, the CAPM.[244]

579. However, not all risks will be compensated in the return on equity. Theory suggests that only those risks that are systematic are 'priced'. This is because unsystematic risk is diversified. Specifically, the exposure of the asset to systematic risks will drive the covariance of the return of the specific asset with respect to the variance of the returns on the overall market for securities.

580. In the theory, non-systematic or 'idiosyncratic' risks for the return on equity may either be:

- diversified away – where idiosyncratic risks influence the *variance* of the expected returns to the asset, then this may be exactly offset through holding other assets in the efficient market portfolio with corresponding offsetting risk and variance; or

[244] Brealey R.A. and Myers S.C. 1996, *Principles of Corporate Finance*, McGraw Hill, p. 173.

- accounted for in the asset's cash flow – to the extent that these risks have the potential to affect the *mean value* of the expected returns.

581. Second, estimates of the rate of return need to be based on the risks and returns of securities issued by firms with similar risk, as the actual risks of the underlying assets of any firm itself are rarely observable.[245] Provided that the risks of the underlying asset and the observed securities are similar, then the observed returns on equity from those securities should reflect the opportunity costs of investing in the underlying assets of the regulated firm.

582. In this context, the National Gas Rules allowed rate of return objective refers explicitly to the need for the benchmark efficient entity to have 'a similar degree of risk as that which applies to the service provider in respect of the provision of the reference services'. As noted in Chapter 4, the Authority interprets a 'similar' degree of risk as allowing for reasonable differences in the degree of risk among firms informing the benchmark, which recognises the significant uncertainties in the risks and the associated wide confidence intervals.

583. Observing the returns for firms with similar risk also allows the regulator to establish the returns for the benchmark efficient entity, as this recognises that the actual returns of the regulated firm may not necessarily be that of the efficient firm. For example, as gearing influences the risk borne by the equity investor, there is a need to account for the gearing in determining the efficient return on equity.

584. Third, there is a need to consider prevailing conditions for the cost of equity, which is a requirement that is set out clearly in National Gas Rules (**NGR**) 87(7). McKenzie and Partington succinctly capture the requirements of the task in terms of this need to apply the prevailing conditions:[246]

> We should... discount the expected future cash flows from the investment at the *current* equilibrium expected return in the capital market, for securities with the investment's level of risk. The word 'current' is important here. In any required return calculation we should be using current values because if capital markets are efficient current values contain the best information available on future values. In particular historic values for the rate of return on equity, or interest rates, are not relevant *except* to the extent that they help us estimate the *current* rates. Since current interest rates are readily observable, historic interest rates typically have no place in determining the required rate of return. If the current interest rates differ from historic rates then there will have been windfall gains or losses that are already reflected in the current value of equity.

585. The Authority is thus required to estimate the prevailing return on equity that compensates investors for holding securities that reflect similar risk to the regulated asset. In what follows, the Authority considers which tools may be used to establish those estimates.

10.2.3 Current practices

586. The model used by Australian regulators for quantifying the return on equity and associated risk to date has been the Capital Asset Pricing Model (**CAPM**). The

[245] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 6.

[246] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 6.

previous NGR specifically referred to this variant of the model as being an example of a 'well accepted' financial model.

587. Other regulators, such as Ofgem in the United Kingdom and the New Zealand Commerce Commission have also adopted the Sharpe-Lintner CAPM as the prime means to estimate the return on equity. The Alberta Utilities Commission also uses the Sharpe-Lintner CAPM, but with scope for qualitative adjustments informed by evidence from other models.

10.2.4 Possible alternative approaches

588. The NGR are explicit that the Authority needs to have regard to *relevant* estimation methods, financial models, market data and other evidence (the new NGR 87(5)(a)). The question then arises as to which of the possible alternative approaches set out at paragraphs 572 to 574 meet this requirement, while also meeting the broader requirements of the National Gas Law, the National Gas Objective and the Revenue and Pricing Principles.

10.2.4.1 Evaluation approach

589. Chapter 2 established a set of criteria that the Authority will use to guide its decision making with respect to assessing or determining what estimation methods, financial models, market data and other evidence can be used to satisfy the rate of return objective. The Authority considers that any approach to estimating the return on equity would need to be broadly consistent with the criteria, in order to be considered relevant. Nevertheless, the Authority recognises that some approaches may perform better on some criteria and less well on others, and yet may still be considered relevant.

590. Overall, the threshold assessment is whether, on balance, the method is consistent with the criteria in Chapter 2. Beyond that, the Authority will exercise judgment based on the criteria, recognising that it is desirable that the preferred approach to estimating the return on equity meets the criteria to greatest extent possible (see Chapter 2).

591. In what follows, the Authority considers the performance of each of the models.

10.2.4.2 Sharpe-Lintner CAPM

592. The Sharpe-Lintner CAPM estimates the return on an asset by quantifying the 'risk premium' for the specific asset over and above the return to a risk free asset. More detail of the formal description of the model is provided in Appendix 11.

593. Only the systematic risk of the asset enters the estimation process (more detail on this issue is set out in chapter 11 - Market risk premium. The model considers that other, non-systematic risks are either diversified away, or included in the operating cash flows.

594. The exposure of the underlying asset to the systematic risk of the overall market is quantified initially through the asset beta (for more detail on the Authority's approach to estimating the beta, see chapter 14 – Equity beta). As a final step, the asset beta is adjusted to reflect the level of gearing, giving the equity beta. The equity beta thus takes account of the additional systematic risk that equity investors achieve through levering up the equity returns of the asset through debt.

595. The Authority considers that the use of the 'on-the-day' risk free rate provides the best estimate of the prevailing *average* return for the risk free portfolio (for more details of this, refer to chapter 11 on the Market risk premium. The use of the on-the-day risk free rate in this way would also be consistent with the Authority's preferred approach to estimating the cost of debt (see chapter 6). This consistent approach to implementing the CAPM ensures that it performs well in terms of National Gas Rule 87(5), as well meeting criteria 'reflecting changes in market conditions' and being 'able to incorporate new information as it becomes available'.[247]

596. The greater the i) level of non-diversifiable risk of the asset, ii) the gearing of the firm, and iii) the risk free rate, the greater is the required or expected rate of return on equity estimated through the CAPM. On this basis, the Sharpe-Lintner CAPM is grounded solidly in theory, and therefore performs well against the criteria that the estimate be 'based on a strong theoretical foundation'.[248]

597. To the extent that the estimates of the key parameters – the risk free rate, the equity beta and the market risk premium – are based on available data, then the model may also be considered to be 'informed by empirical analysis', and 'implemented in accordance with best practice'. In particular, there are many studies of the three inputs used in the Sharpe-Lintner CAPM. There is a good understanding of the factors driving the outcomes of the model, and the results for these parameters are well accepted. These strengths apply for applications of the model within the Australian context, so the model fits well with the Authority's preference to retain a domestic estimation approach.

598. The Authority considers that the CAPM also performs strongly in terms of being 'supportive of specific regulatory aims', particularly the desirability to 'promote economic efficiency' (see chapter 4 and Appendix 3 on incentive regulation).

599. As noted by McKenzie and Partington, 'without doubt, the CAPM is the most widely used model for estimating the cost of equity in regulated companies'.[249] This widespread use reflects the model's simplicity and foundation in theory. Myers notes that the CAPM is simple and logical, and with careful application,

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[247] National Gas Rule 87(5) states that in determining the *allowed rate of return*, regard must be had to:

(a) relevant estimation methods, financial models, market data and other evidence;

(b) the desirability of using an approach that leads to the consistent application of any estimates of financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt; and

(c) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt.

[248] Specifically, the Sharpe-Lintner CAPM is grounded in Markowitz's portfolio theory on the relationship between risk and return. This mean-variance theory provided the first rigorous measure of risk for investors and showed how one selects alternative assets to diversify and reduce the risk of a portfolio. It also derived a risk measure for individual securities within the context of an efficient portfolio. Based on this theory, Sharpe and several academicians extended the Markowitz's model into a general equilibrium asset pricing model that included an alternative risk measure for all risky assets (see for example, Reilly and Brown 2006, *Investment Analysis and Portfolio Management*, 8th Edition, p. 229).

By accounting for gearing in the equity beta, the Sharpe-Lintner CAPM is also consistent with Modigliani and Miller's theorem that i) a firm cannot change the total value of its securities just by splitting its cash flows into different streams, such as returns to debt and equity, and ii) the expected rate of return on equity of a levered firm increases in proportion to the debt-equity ratio (see, for example, Brealey R.A. and Myers S.C. 1996, *Principles of Corporate Finance, McGraw Hill*, p. 447).

[249] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 24.

tends 'to give estimates of the cost of equity that are sensible and reasonably stable over time'.[250] The Brattle Group note that 'the CAPM is a well-founded and commonly used model that relies primarily on readily available information'.[251]

600. However, the CAPM has been criticised on the grounds that:[252]

- empirical evaluation suggests that the CAPM does not perform well in explaining the return on equity when tested with actual outcomes;
- the CAPM model is not stable or may not be used in an internally consistent way, particularly when a prevailing cost of debt is used in conjunction with long term estimate of the market risk premium;
- other models perform better in estimating the returns to equity, including in relation to the effects of consumption or economic growth, technological or regulatory risks, and changes through time or the dynamics of investment behaviour and hedging;
- the model is based on the assumption that all investors optimally hold well diversified portfolios and therefore only care about systematic risks, whereas investor expectations about returns and investment opportunities are heterogeneous.

601. First, the view that the CAPM performs poorly on empirical grounds reflects analysis with ex post data which indicates that the slope of the security market line is flatter than that predicted by the estimated CAPM beta, so that returns on stocks with higher betas are systematically less than predicted by the CAPM, whereas returns on stocks with lower betas are systematically higher.

602. The Authority notes however that the CAPM is an *ex ante* model which seeks to predict the return on equity. The result that actual outcomes might differ ex post does not mean that the model is wrong. The CAPM is supported when it is tested as an ex ante model. As summed up by Levy:[253]

> ...experimental studies allow us to design an experiment such that the equilibrium model is tested with ex ante parameters. We find strong support for beta as a measure of risk, and the coefficient of determination is very high. These results conform to the recent studies that do not reject the CAPM when one accounts for the difference between ex post and ex ante betas or other parameters that composed the betas.

603. Second, the Authority considers the issue of the internal consistency of the estimate of the risk free rate and that of the market risk premium in detail in chapter 11 - Market risk premium.

604. Third, the Authority is open to considering other models which have merit in explaining the return on equity in the Australian setting. The performance of these other models is considered below.

605. Fourth, there is a considerable literature which considers the influence of investors' expected utility on their investment choices, and potential violations in

[250] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, Schedule 1, p. 3.

[251] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, Schedule 2, p. 19.

[252] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, Schedule 2, p. 18.

[253] Levy, H 2012, *The Capital Asset Pricing Model in the 21st Century*, Cambridge University Press, p. 236.

this regard with the mean-variance assumptions underpinning the CAPM. However, even where the CAPM's assumptions are violated, it may be shown that the CAPM nevertheless provides a very close approximation for optimal choices made by investors.[254] More recently, behavioural economics and prospect theory have advanced understanding of decision making under uncertainty, and provide further support for the CAPM. As summarised by Levy:[255]

> ...when diversification is allowed (e.g. financial assets), the two paradigms, prospect theory and the mean-variance efficiency analysis, yield almost the same efficient frontier, and when a riskless asset is added, these two paradigms yield the same frontier; therefore, the CAPM is also intact.

606. In summary, the Authority considers that the CAPM remains an important tool for evaluating the return on equity. While it is true that the CAPM may not fully explain investor returns with precision, it performs as well, if not better than many other models ex ante, and is therefore 'fit for purpose'. It is also is empirically tractable within an Australian context.

10.2.4.3 Other models of the CAPM family

607. The range of other models in the CAPM family include:

- the Black and Empirical CAPM;
- the Consumption CAPM; and
- the Inter-temporal CAPM.

608. The formal description of these models is also set out in Appendix 11.

The Black and Empirical CAPM

609. The Black CAPM developed as a response to the ex post empirical assessment of the performance of the Sharpe-Lintner CAPM, and its resulting perceived shortcomings, as noted above. The Black CAPM belongs to the Empirical CAPM family of models, which adjust the parameters of the Sharpe-Lintner CAPM to align with the ex post outcomes that are observed. The Black and Empirical CAPM results are considered to be closer to the ex post outcomes from the data: (i) when β is low, the expected return predicted by the Sharp-Lintner CAPM is less than the expected return predicted by the Black and Empirical CAPM; and (ii) when β is high, the expected return predicted by the Sharp-Lintner CAPM is greater than the expected return predicted by the Black and Empirical CAPM.

610. To estimate the cost of equity, the Black CAPM requires a risk free rate, an estimate of the zero-beta premium, an equity beta and a market risk premium. Except for the zero-beta premium, all other parameters are the same as those used in the Sharpe-Lintner CAPM.

[254] Levy, H 2012, *The Capital Asset Pricing Model in the 21st Century*, Cambridge University Press, p. 116.
[255] Levy, H 2012, *The Capital Asset Pricing Model in the 21st Century*, Cambridge University Press, p. 374.

611. In the Australian context, NERA Economic Consulting (**NERA**) has presented estimates derived from the Black CAPM, both for DBNGP Pty Ltd and most recently, for Envestra.[256]

612. The Authority considered NERA's proposal provided by DBNGP Pty Ltd at length as part of its determination for its decision on the Dampier to Bunbury Natural Gas Pipeline access arrangement.[257] The Authority concluded that the Black CAPM was not widely used in Australia, and did not produce reliable estimates within an Australian context.

613. In the report for Envestra, NERA submitted a range for the mean return to a zero-beta asset of between 6.99 and 8.15 per cent per year.[258] NERA suggest that the empirical version of the Black CAPM better explains the cross section of mean returns to Australian stocks than does the Sharpe-Lintner CAPM, that the zero-beta estimates may be based on historic data, and that the Black CAPM will provide a better estimate of the return to the zero beta portfolio than the Sharpe-Lintner CAPM.

614. McKenzie and Partington, in their critique of the NERA estimates, considered that:[259]

- the estimates imply that the return on equity is a constant across shares and through time, which is implausible, not consistent with theory, nor reflective of prevailing market conditions;
- estimates of the magnitude of the zero beta return are not robust, and further, large differences in the value are possible given the estimation approach, such that any estimate should be viewed with great caution;
- there are unresolved issues relating to the standard error of the zero beta estimates, which is important as this is the basis for concluding whether the estimated zero beta returns differ from zero;
- there are internal inconsistencies in the empirical estimates and the final values adopted in the model to estimate the return on equity; and
- there is no link to theory, without which 'all we have is a regression... [which] boils down to being a constant and that constant is simply an estimate of the average return on the market'.[260]

615. The Authority is of the view that there is no basis for the existence of a zero-beta portfolio. This view is supported by the fact that there is no underlying theory supporting the Black CAPM. The Authority considers that there should be an arbitrage opportunity available between the CGS bonds (which proxy for the risk-free rate of return) and the zero-beta portfolio.

[256] See NERA Economic Consulting 2011, *Estimating the Required Rate of Return on Equity for a Gas Transmission Pipeline: an Update for DBNGP*, www.erawa.com.au and NERA Economic Consulting 2012, *The Black CAPM: A report for APA Group, Envestra, Multinet & SP AusNet*, www.aer.gov.au.

[257] Economic Regulation Authority 2011, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, www.erawa.com.au, p. 156.

[258] NERA Economic Consulting 2012, *The Black CAPM: A report for APA Group, Envestra, Multinet & SP AusNet*, www.aer.gov.au, p iv.

[259] McKenzie M. and Partington G. 2012, *Review of NERA Report on the Black CAPM*, www.aer.gov.au.

[260] Ibid, p. 6.

616. The Authority remains of the view that the Black or Empirical CAPM is not widely used in Australia, and does not produce reliable estimates within an Australian context.

617. On this basis, the Authority considers that without some new development of the model in terms of its theoretical linkages, the Black and Empirical CAPM models would appear to have shortcomings with regard to being 'fit for purpose' and 'implemented in accordance with best practice', and are thus unlikely to provide a robust basis for estimating the return on equity in the Australian context.

Consumption CAPM

618. The Consumption CAPM assumes that investors seek to maximise their lifetime utility of consumption, with the beta in the CAPM measuring the covariance of the underlying asset to the variance of aggregate consumption.[261]

619. Breeden, Gibbons and Litzenberger (1989) argued that this model is difficult to utilise in practice due to the difficulty in estimating consumption.[262] In addition, these authors consider that the consumption-based CAPM has been shown to have poor performance relative to the standard CAPM.

620. The Brattle Group refer to the Ahern model as a version of the consumption CAPM developed explicitly to estimate the cost of equity for regulated entities. The estimate of the return for the firm is based on conditional volatility with regard to the stochastic discount factor, which is the aggregate consumption inter-temporal marginal rate of substitution.[263] However, the Brattle Group also note:[264]

> The model has been presented in some U.S. regulatory jurisdictions but regulatory decisions based on the model are either still pending or it is not clear how the regulator used the information.

621. The Brattle Group consider that the Consumption CAPM allows for empirical evaluation, but also note that the results are sensitive to prevailing economic conditions and the models have not been implemented outside of the US market setting.[265]

622. There appear to have been no Australian studies based on the model.

623. Overall, the Authority considers that the consumption-based CAPM has not been used to estimate expected asset returns in Australia. Without further empirical

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[261] McKenzie M. and Partington G. 2013, Risk, Asset Pricing and the WACC, DRAFT Report to the AER, provided as part of workshop materials, p. 22.

[262] Breeden D.T, Gibbons M.R and Litzenberger R.H(1989), Empirical Tests of the Consumption-Oriented CAPM, *The Journal Of Finance*, Vol XLIV.

[263] McKenzie and Partington discuss Stochastic Discount Factor (**SDF**) models as a type of meta asset pricing approach – where the value of the financial asset equals the expected value of the product of the payoff on the asset and the Stochastic Discount Factor (McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC,* DRAFT Report to the AER, provided as part of workshop materials, p. 19 and p. 41):

> The basic intuition of the model is that both cash flows and discount rates may vary according to future states of the world.

The Sharpe-Lintner CAPM may be configured within the context of the SDF, as may intertemporal models such as the Consumption CAPM and the Intertemporal CAPM.

[264] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, Schedule 2, p. 23.

[265] The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, Schedule 2, p. 24.

development for the Australian context, this family of models has shortcomings with regard to being ‘fit for purpose’ and ‘implemented in accordance with best practice’.

Inter-temporal model

624. The Inter-temporal CAPM relates changes in the return on the asset to changes in inter-temporal state variables. The betas in the model are estimated as the covariance of the portfolio returns with the variance in the state variables.

625. The Consumption CAPM is a form of the Inter-temporal model in which the state variable is the utility of aggregate consumption over time. Other potential state variables in the Inter-temporal model include income and investment opportunities, as well as measures of stock market volatility.

626. Recently, NERA proposed to the Australian Energy Regulator (**AER**) a regime switching model based on the Inter-temporal CAPM, which relates estimates of the market risk premium to states of stock market volatility, in particularly the probability that it is in a state above or below the long run unconditional mean. However, a review of the model for the AER by McKenzie and Partington concluded that some aspects of the results are implausible and that ‘the NERA (2012) model does not provide a good model of volatility’.[266] The AER noted that the use of a Markov chain to govern the transition from one state to another, and the stochastic nature of the states, implies there is greater uncertainty in the estimated current state. In consequence, the AER placed limited emphasis on the regime switching model in estimating the value of the market risk premium,

627. Overall, unlike the CAPM, the model has not found widespread use or acceptance. McKenzie and Partington state that:[267]

> The main problem with operationalising the I-CAPM is that it is not easy to identify the state variables that affect expected returns. ...In terms of the regulatory use of the I-CAPM, to the best of our knowledge, there has not been a regulatory body that has relied on this version of the CAPM to estimate the cost of capital.

628. Overall, the Authority considers that like the Consumption CAPM, the Inter-temporal CAPM has not been used to estimate expected asset returns in Australia. Without further empirical development for the Australian context, the model would appear to have shortcomings with regard to being ‘fit for purpose’ and ‘implemented in accordance with best practice’.

10.2.4.4 The Fama French Model

629. The Fama-French Three-Factor Model (**FFM**) claims three sources of undiversifiable risk:

630. The excess return to the market portfolio (the market risk premium, **MRP**);

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[266] McKenzie M. and Partington G. 2012, *Review of Regime Switching Framework and Critique of Survey Evidence*, www.aer.gov.au, p. 5. In particular, McKenzie and Partington use evidence from a study by Brailsford, Handley and Mahareshwan, which indicates that there is no compelling reason for the two regimes adopted by NERA, and that a greater number of regimes could be justifiable (p. 20).

[267] McKenzie M. and Partington G. 2013, Risk, Asset Pricing and the WACC, DRAFT Report to the AER, provided as part of workshop materials, p. 29.

631. The value or growth risk premium, high minus low (**HML**) – the premium earned by HML book value shares. In this asset pricing model, high-value firms have a high ratio between book value of equity and market value of equity whereas the opposite is true for low-value firms (also known as growth shares). HML is a risk premium associated with the returns earned by firms with high book-to market values of equity. It has been observed that firms with high book-to-market values (known as value stocks) tend to have higher *realised* returns than that of firms with low book-to-market values (known as growth stocks). The FFM considers that the higher realised return of stocks with high book-to-market values represents a risk factor that investors cannot diversify, and as a consequence, the HML risk premium is a compensation for investors incurring this risk; and

632. The size risk premium, small minus big (**SMB**) – the premium earned by SMB shares. Small (big) firms have small (big) total capitalisation (i.e. equity at market value). SML is a risk premium associated with the differential in returns earned by small market capitalisation firms in comparison with large capitalisation firms. The FFM is built on the observed empirical evidence that small market capitalisation firms tend to earn a higher return than firms with larger market capitalisations. It is assumed that this is due to smaller market capitalisation firms being riskier than larger market cap firms. As a consequence, the FFM contains a risk premium in compensation for investors incurring this form of risk.

633. There is no theory that explains the choice of factors, the exact form of the variables used, or reasons why these are common factors in returns.[268] In common with its observations on the Empirical CAPM, the Authority notes that the FFM explains ex post returns, but it is not clear that the model performs well in explaining returns ex ante. This view is summarised by Smith and Walsh:[269]

> The market portfolio is important and special because it is the only portfolio which we can specify ex ante to be an efficient portfolio. In the words of Roll:
>
> > in any sample of observations on individual returns... there will always be an infinite number of ex post mean variance efficient portfolios. For each one, the sample betas calculated between it and individual assets will be exactly linearly related to the individual sample mean returns...
>
> What does this mean for the Fama and French factors? ...we are left with the fact that the empirical content of the CAPM is to be judged by the only *ex ante* efficient frontier portfolio that we know of – the market portfolio. The use of *ex post* factors based on size or market to book or the position in the alphabet of the company name falls into the trap of the mathematical tautology...

634. The FFM was proposed by Dampier to Bunbury Pipeline as part of its proposal to the Economic Regulation Authority for the 2011 - 2015 Dampier to Bunbury Natural Gas Pipeline access arrangement, and also to the Australian Energy Regulator by Jemena for its most recent NSW Gas Networks proposal. [270,271] Both proposals drew on work by NERA.

635. NERA is of the view that the Fama and French original study shows that the Sharpe-Lintner CAPM is unable to explain the returns for firms with low market

[268] Ibid.

[269] Smith T. and Walsh K. 2013, Why the CAPM is Half-Right and Everything Else is Wrong, *Abacus*, Volume 49, Supplement, p. 75.

[270] Dampier Bunbury Pipeline Pty Ltd 2010, *Revised Access Arrangement Proposal Submission: Supporting document from NERA – The required rate of returns on equity for a gas transmission pipeline*, pp. 21-24.

[271] Australian Energy Regulator 2010, *Final Decision, Jemena Gas Networks: Access arrangement proposal for the NSW gas networks*, 1 July 2010 – 30 June 2015, pp. 170-171.

capitalisation and firms with high book-to-market ratios.[272] Using data for 25 portfolios from Ken French's website, NERA submitted that small firms with high book-to-market values have had alphas[273] of six per cent per year in the last 83 years (from 1927 to 2009) relative to the Sharpe-Lintner CAPM, whereas these portfolios deliver only one per cent per year difference relative to the FFM over the same period.

636. With regard to this point, the Authority notes that the 1993 Fama-French paper established the FFM in the context of the US market. As noted in Chapter 2, the Authority is of the view that the relevant context is the Australian capital market.

637. Furthermore, the original empirical study by Fama and French is now almost 20 years old. In the interim, many academic papers have employed different datasets, in different periods of time to test the validity of the FFM, including for Australia. No consistent conclusion has been reached. In consequence, the Authority is of the view that practical applicability of the FFM is, to some extent, limited for the purpose of estimating a forward-looking rate of return.

638. To inform the FFM in an Australian context, NERA submitted that a 2008 study by O'Brien, Brailsford and Gaunt found similar results to those from the US with a time series of Australian data.[274] The Authority notes that Brailsford, Gaunt and O'Brien have recently updated their work. Their 2012 study observes that prior Australian research has suffered from limited datasets, resulting in mixed and weak results compared to US studies.[275] For their 2012 study, Brailsford, Gaunt and O'Brien utilised a new and specially constructed dataset that provides coverage of over 98 per cent of listed Australian firms over the 25-year period of 1982-2006.

639. McKenzie and Partington consider that the 2012 Brailsford, Gaunt and O'Brien study provides support for the FFM model in the Australian context, particularly with respect to the book to market factor.[276] However, similar to a study by Faff in 2004, there was a negative risk premium for the size factor, although statistically it was not significantly different from zero. The Authority is of the view that there are significant concerns with models which utilise ex post data to derive the estimates without underlying theoretical support.

640. NERA also proposed a zero-beta version of the FFM, which utilises all the parameters required by the FFM, together with the estimate of zero-beta premium. NERA used an estimate of the zero-beta premium, derived from its estimation of the Black CAPM, of 6 per cent. However, NERA did not provide any supporting evidence from academic papers or other practical examples of the use of the zero-beta FFM in Australia.

[272] Fama, Eugene and Kenneth French, Common risk factors in the returns to stocks and bonds, *Journal of Financial Economics* 33, 1993, p. 35.

[273] An asset's alpha is a measure of the error with which a model prices the asset. It is the difference between the mean return to the asset and the return the model predicts the asset should earn on average. If an asset has a positive (negative) alpha, the model underestimates (overestimates) the return the market requires the asset earn. As a general guide, a model that produces large alphas is a model that will produce poor estimates of the cost of equity.

[274] O'Brien, Michael, Tim Brailsford and Clive Gaunt, Size and book-to-market factors in Australia, Table 3, Electronic copy available at: http://ssrn.com/abstract=1206542.

[275] Brailsford T, Gaunt C and O'Brien M.A (2012), 'Size and book-to-market factors in Australia', *Australian Journal of Management* 37(2) 261-281 Aug 2012.

[276] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 33.

641. In its recent final decision for Jemena – the New South Wales Gas Distribution network – the AER did not accept the use of FFM to derive the cost of equity.[277] The AER's decision rejecting the use of the FFM to estimate the cost of equity for regulated businesses was based on the following reasons.

- There is no strong theoretical basis to support the inclusion of the additional FFM risk factors for the rate of return on equity. Evaluation of the academic literature does not support the FFM as a reliable or accurate financial model.
- Analysis from Australia, which is the relevant market for funds, shows that observed empirical evidence is not consistent with the FFM, with conflicting, variable FFM risk premia and inconsistent FFM factor coefficients. This means that it is unreasonable to conclude that the additional FFM risk factors are present in the market for funds and can be used to determine a rate of return on equity.
- In relation to evidence in other markets for funds:
  - analysis from a global perspective (including the UK, Japan and Germany) shows that the observed empirical evidence is not consistent with the FFM; and
  - analysis from the US shows conflicting evidence that does not support the FFM for each time period analysed.

642. As noted above, the Authority has significant concerns with models which utilise ex post data without underlying theoretical support. The Authority agrees with McKenzie and Partington when they say:[278]

> In summary, the Fama and French three factor model provides no clear guidance on exactly what are the risk factors that are priced. There are also some somewhat arbitrary choices that must be made in measuring the factor risk premiums as the return to the spread portfolios.[279] Furthermore the empirical evidence suggests ambiguity about the magnitude of the premiums and even their sign. Despite these issues, the Fama and French three factor model has been used as a method to estimate the cost of equity. However, to do so requires significant effort in estimating factor risk premiums and factor loadings with no clear evidence that an improved estimate of the cost of capital results relative to the simpler CAPM.

643. Davis provides the following view: [280]

> The Fama-French factors can be constructed for the Australian equity market, making implementation of this model feasible. However, the results of studies attempting to implement a Fama-French model for Australia have had mixed results, and my opinion based on examining these studies is that there is not strong evidence to support its use.

644. Overall, the Authority has concerns as to the robustness of the FFM model specification and its results, particularly as the model is not 'based on a strong theoretical foundation'. In addition, without further empirical development, the

[277] Australian Energy Regulator, 2010, Final Decision, Jemena Gas Networks: Access arrangement proposal for the NSW gas networks, 1 July 2010 – 30 June 2015, pp. 170-171.

[278] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 35.

[279] One procedure is to take the top 30 percent of the firms and bottom 30 percent of firms. For example, the difference in returns to a portfolio of the bottom 30 percent of firms by book to market and the top 30 percent by book to market gives the return to the book to market factor, but other choices would be just as valid.

[280] Davis K. 2011, *Cost of Equity Issues: A Report for the AER*, www.aer.gov.au, p. 13.

model would appear to have shortcomings with regard to being 'fit for purpose' and 'implemented in accordance with best practice'.

10.2.4.5 Arbitrage Pricing Theory

645. Arbitrage Pricing Theory (**APT**) was developed as an alternative to the CAPM. A key difference in the APT is that, unlike the CAPM, risk aversion and normality of returns is not assumed.[281] Rather, returns are related to a set of factors, with the assumptions that:

- the returns are generated by some specific process that is captured in the factors;
- investors hold a portfolio of numerous assets, some of which may be in a short position.

646. The APT assumes that if deviations from the equilibrium occur, an arbitrage profit becomes available, and this may be used to increase holdings in long positions.[282] Formal specification of the APT is set out in Appendix 11.

647. It has been argued that APT is theoretically superior to CAPM in that it allows for several systematic factors to influence stock returns.[283] In addition, some research suggests that multivariate APT models explain expected rates of return better than the Sharp-Lintner CAPM.[284] However, choice of risk factors is not straightforward:[285]

> Unfortunately, extant asset pricing models do not provide a consensus on what the systematic risk factors are...

648. Furthermore, implementing the APT can be difficult in that *n* risk premiums need to be estimated, whereas the CAPM requires only one, the market risk premium. In addition, *n* sensitivities have to be calculated as opposed to CAPM which requires only one, the beta. Additionally, as there is no general consensus about which variables to include in the APT, the model is seen as being vulnerable to data mining, as well as been sensitive to the variables chosen.[286]

649. To the Authority's knowledge, the APT model has not been proposed before in the Australian regulatory context.

650. Overall, the Authority considers that the APT has not been used for estimating expected asset returns in Australia. More importantly, there are concerns as to the robustness of the model specification and its results, particularly as the model is not 'based on a strong theoretical foundation'. In addition, without further empirical development, the model would appear to have shortcomings with regard to being 'fit for purpose' and 'implemented in accordance with best practice'.

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[281] Levy, H 2012, *The Capital Asset Pricing Model in the 21st Century*, Cambridge University Press, p. 180.

[282] Levy, H 2012, *The Capital Asset Pricing Model in the 21st Century*, Cambridge University Press, p. 180.

[283] Brigham E.F & Ehrhardt M.C(2008), *Financial Management: Theory and Practice.* Thomson Learning Inc p. 267.

[284] Pratt, S.P & Grabowski, R.J (2010), *Cost of Capital Applications and Examples, Fourth Edition.* John Wiley & Sons p. 353.

[285] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 6.

[286] Pratt, S.P & Grabowski, R.J (2010), *Cost of Capital Applications and Examples, Fourth Edition.* John Wiley & Sons p. 354.

10.2.4.6 Dividend Discount Models

651. Dividend Discount Models (**DDM**) seek to estimate the internal rate of return which equates the present value of the expected stream of future returns with the present value of the underlying asset value. Future returns may include dividends, retained earnings or other cash flows. Share repurchases and capital contributions such as dividend reinvestment plans need to be excluded. Importantly, account needs to be taken of implicit tax cash flows, which will depend on the specific taxation treatment.

652. DDM may be based on either a single stage or multi-stage internal rate of return. For more detail of estimation approaches for the DDM family of models, see Appendix 11.

653. DDM are based on an 'implied' return on equity, and are therefore not derived from any theoretical underpinning as to what prices the return. DDM do not identify the risks which investors bear in exchange for the expected future return, although McKenzie and Partington note that in the DDM:[287]

> ...the only stochastic variable is the expected dividend. While the dividend growth rate is usually written as a fixed parameter in the model, the reality is that the growth rate is uncertain and this translates into ongoing uncertainty of the magnitude of the dividend through time. Thus, the risk that is recognised in the DGM, and therefore presumably driving the required return, is uncertainty over future cash flows in the form of dividends.
>
> This is consistent with asset pricing models where uncertainty over future cash flows is the key risk.

654. Estimates of the dividend yield and other cash flows are generally based on information such as broker reports, in conjunction with views about longer term sustainable growth rates. As such, the estimates are subjective, and may be subject to systematic bias, particularly estimates of growth rates (see section on broker reports below).[288]

655. Furthermore, in this context, it is not always clear what implicit framework is driving the assumptions relating to the inputs for the model, for example whether there is alignment between the return expected by brokers and that underpinning the regulatory calculation. In this context, the Brattle Group note that the inputs can be controversial, particularly relating to the dividends:

> To implement the DDM it is necessary to specify one or more growth rates and to determine whether (i) dividends accurately reflect cash flow to shareholders, (ii) the horizon over which to apply each growth rate if using a multi-stage model, and (iii) the exact determination of the initial stock price. In most applications, the choice of growth rate is the most controversial part of the DDM implementation and the determination of the stock price is the least controversial.

656. The Authority also notes that the cash flows for the regulated business are established by the regulator through the building block approach. Thus there is an element of circularity, to the extent that future cash flows – which include the

[287] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 38.

[288] SFG Consulting note 'that there is empirical evidence that the earnings forecasts of equity analysts are somewhat optimistic on average', citing three separate journal articles to this effect (SFG Consulting 2010, *The required return on equity commensurate with current conditions in the market for funds*, Report prepared for WA Gas Networks, www.erawa.com.au, p. 18).

expected return on equity – are used to inform the broker's expected return on equity.[289]

657. Second, when it comes to the valuing the assets, the broker will use the share price. However, there may be inconsistencies in the broker's estimate of the share price and the associated estimate of the dividend. It is not clear whether broker bias with regard to dividend cash flows will necessarily be related to views on the asset value or the target price.[290]

658. The Brattle Group notes that the DDM model has been used in the United States and that:[291]

> More recent DDM implementations have focused on variations of the multi-stage model described above. For example, the U.S. Surface Transportation Board relies on a version of the multi-stage DDM that uses cash flow rather than dividends and specifies three growth rates – a near-term company-specific growth rate, an intermediate industry-specific growth rate and a long-term economy-wide growth rate.

659. The Authority is not aware of use of the DDM by Australian regulators to estimate the cost of equity. However, the single stage Dividend Growth Model (**DGM**) has recently been proposed to the Australian Energy Regulator (**AER**) as a means to estimate the Market Risk Premium. The AER however rejected the use of the DGM approach, noting a number of shortcomings, including – among other things – that it is sensitive to inputs, tends to produce an extremely wide range of estimates, and has at times produced unacceptable results.[292]

660. Overall, the Authority has concerns as to whether the DDM approach is 'implemented in accordance with best practice', particularly as the model is based on subjective views and is not 'based on a strong theoretical foundation'. Without further development, the approach would appear to have shortcomings with regard to being 'fit for purpose' in an Australian context.

10.2.4.7 Residual Income Model

661. The Residual Income Model (**RIM**) may be used to estimate the value of a company, by summing the invested capital – taken from the historic book value – plus the discount present value of estimated 'residual income'. Residual income is estimated as the excess of the company's earnings over its cost of capital. More detail on the formal definition of the RIM is at Appendix 11.

662. The Residual Income Model in many respects is an identical framework to the DDM approach, with the difference being use of gross cash flows (earnings and

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289 A further issue relates to the possibility that there may significant amounts of non-regulated assets in the business represented by the cash flows. Other issues relating to the cash flows include the importance of capturing all cash flows, particularly implicit cash flows relating to tax.

290 For a summary of work on broker bias, see SFG Consulting 2010, *The required return on equity commensurate with current conditions in the market for funds, Report prepared for WA Gas Networks*, www.erawa.com.au, p. 18. With regard to this report, the Authority notes that it does not consider that using broker target stock prices will necessarily offset broker bias with regard to dividend cash flows. SFG Consulting make this claim but provide no supporting evidence. It is not clear to the Authority as to whether the bias applies equally to dividends or target stock price. It is possible that the bias applies only to dividends, and hence the return on equity.

291 The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, Schedule 2, p. 29.

292 Australian Energy Regulator 2013, *Access arrangement final decision: SPI Networks (Gas) Pty Ltd 2013 – 2017,* Part 2 Attachments, www.aer.gov.au, pp. 101 – 103.

cost of capital) rather than net cash flows (dividends).[293] For this reason, the analysis relating to the DDM above is equally applicable to the Residual Income Model, and vice versa.

663. A recent proposal based on the RIM was that considered by the Authority in 2010 as part of its decision on the Western Australian Gas Networks (**WAGN**) access arrangement. The estimate was developed by SFG Consulting.[294]

664. The residual income model, used by SFG in its submission, is as follows:

665.

$$V_0 = BVPS_0 + \sum_{t=1}^{T} \frac{(ROE_t - r_e)\ x\ BVPS_{t-1}}{(1+r_e)^t} + \frac{(ROE_t - r_e)\ x\ BVPS_{T-1}\ x\ (1+\text{g})}{(\text{r}_e - \text{g})\ x\ (1+r_e)^T} \quad (10)$$

where

V_0 is the estimated value per share;

$BVPS_0$ is the current book value per share;

$BVPS_t = BVPS_{t-1} + EPS_t - DPS_t$ where DPS_t is estimated as the historical dividend payout ratio multiplied by EPS_t;

r_e is the cost of equity; and

g is the perpetual growth; T is the length of the forecast period.

666. SFG's approach is that three parameters in its model are simultaneously estimated, including a perpetual growth (g); the long-term return on book equity (ROE_T); and the cost of equity (r_e).

667. SFG applied the above model to a set of comparable firms, as in the approach using the brokers' research reports. Two data sets were used to estimate the cost of equity: (i) analyst forecasts from the I/B/E/S/ database;[295] and (ii) brokers' research reports.[296]

668. However, regarding the second approach used in SFG's report, the Authority concluded that there were significant issues associated with SFG's analysis.[297]

[293] Lundholm R. and O'Keefe T. 2001, Reconciling value estimates from the discounted cash flow model and the residual income model, *Contemporary Account Research*, 18 (2), pp. 311 – 335 quoted in SFG 2010, *The required return on equity commensurate with current conditions in the market for funds*, Report for WA Gas Networks, www.erawa.com.au, p. 15.

[294] SFG Consulting 2010, *The required return on equity commensurate with current conditions in the market for funds, Report prepared for WA Gas Networks*, www.erawa.com.au.

[295] The Institutional Brokers Estimate System (I/B/E/S) is a unique service which monitors the earnings estimates on companies of interest to institutional investors. The I/B/E/S database currently covers over 18,000 companies in 60 countries. It provides to a discriminating client base of 2,000 of the world's top institutional money managers. More than 850 firms contribute data to I/B/E/S, from the largest global houses to regional and local brokers, with US data back to 1976 and international data back to 1987.

[296] For more detail on the latter broker reports, refer to paragraph 687 below.

[297] Economic Regulation Authority 2011, *Final Decision on WA Gas Networks Pty Ltd proposed revised access arrangement for the Mid-West and South-West Gas Distribution Systems*, www.erawa.com.au, p 100.

Based on those concerns, the Authority did not approve the use of brokers' research reports and the RIM as proposed by SFG to estimate the cost of equity for WAGN.

669. A recent report for Ofgem rejected putting weight on the Residual Income Model, on the grounds that:[298]

> It is not as widely used in practice and relies heavily on the quality of accounting information, which can lead to mis-estimation of the implied cost of equity. This is particularly true for companies which have significant intangible assets or assets recorded at cost on the balance sheet which do not reflect market values.

670. Overall, similar to the DDM, the Authority has concerns as to whether the RIM approach is 'implemented in accordance with best practice', particularly as the model is based on subjective views and is not 'based on a strong theoretical foundation'. Without further development, the approach would appear to have shortcomings with regard to being 'fit for purpose'.

10.2.4.8 Risk Premium

671. The Risk Premium approach typically uses the historical spread between returns from entities in the same industry – based on either accounting conventions or stocks – and the return from a given debt instrument to estimate a premium. This estimated risk premium then acts as a margin added to returns observed on the debt instrument. More detail on the formal definition of the Risk Premium approach is at Appendix 11.

672. The model represents a simplified version of the CAPM. As such, the results should be similar, if the model inputs are well specified. However, the Brattle Group observe in this context:[299]

> There are many versions of this model depending on the choice of the debt instrument, r_D, and the estimation of the risk premium. It is important to note here that the risk premium approach, while a generalized form of the CAPM, does not have the same level of theoretical support as the standard CAPM. This is because the return on the selected debt instrument used is not necessarily equal to the risk-free rate, and the estimated risk premium used is not explicitly based upon the product of the market beta and the MRP.

673. The Authority notes that the model may be simpler to implement in practice than the CAPM.

674. The Authority also notes that the model is not related to specific risk factors, and hence lacks a strong theoretical foundation. In this context, the Brattle Group observe that is common for analysts to rely on DDM models when determining the risk premium in forward looking versions of the model.[300] For this reason, the Authority has reservations about the use of the model in an Australian context, for the reasons outlined above in regard to the DDM.

675. Overall, the Authority is not convinced the model is able to be 'implemented in accordance with best practice', particularly as the model is based on subjective views and is not 'based on a strong theoretical foundation'. Without further

[298] FTI Consulting 2012, *Cost of capital study for the RIIO-T1 and GD1 price controls*, www.ofgem.co.uk, p. 11.

[299] Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Schedule 2, p. 33.

[300] Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Schedule 2, p. 34.

development, the approach would appear to have shortcomings with regard to being 'fit for purpose'.

10.2.4.9 Build-up Method

676. The cost of equity is calculated as a sum of the risk free rate, market risk premium, firm size premium, industry premium and premiums for any other factors that capture specific risks. More detail on the formal definition of the Build-up Method is at Appendix 11.

677. The model is used by Ibbotson to estimate returns to equity for selected stocks.[301]

678. The Authority notes that the Build-up Method has characteristics in common with both the Empirical CAPM and Arbitrage Pricing Theory. As such, the Authority has similar reservations about the Build-up Method as with these models, considering that it:

- is not grounded in theory;
- 'mines' ex post data; and
- is subjective, depending on the choice of premia and the method for determining those premia.

679. Overall, the Authority is not convinced the method is able to be 'implemented in accordance with best practice', particularly as it is not 'based on a strong theoretical foundation'. Without further development, the approach would appear to have shortcomings with regard to being 'fit for purpose'.

10.2.4.10 Comparable Earnings

680. The Comparable Earnings method involves assessing returns based on those for a group of comparable companies. As such, care is needed to ensure risk characteristics are as comparable as possible.

681. The Brattle Group note that the Comparable Earnings approach requires comparison with firms that are not regulated, to avoid circularity problems. Adjusting for risk characteristics then becomes an important element in the analysis, which is usually based on the subjective view of the analyst.[302] The Brattle Group note a number of significant issues with regard to the Comparable Earnings approach:[303]

> A major issue is whether realized book returns are a good proxy for the returns that investors expect going forward. From a statistical perspective, the realized accounting return on book equity for any given period is the realization of a single outcome of a distribution, whereas the expected return represents the probability-weighted average of all possible outcomes of the distribution. These two figures can differ substantially. In addition, there are practical problems with the implementation of this model because financial reporting occurs with a lag, which during times of change can mean that the results are out of date.

682. The approach provides for a simple check. However, the Authority notes that the evidence on comparable investments is generally inconclusive regarding the

[301] Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Schedule 2, p. 36.
[302] Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Schedule 2, p. 37.
[303] Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Schedule 2, p. 38.

return investors expect and there may be limited evidence to suggest that these returns are sufficiently comparable to the regulated utilities.

683. Overall, the Authority is not convinced the method is able to be 'implemented in accordance with best practice', particularly as it is not 'based on a strong theoretical foundation'. Without further development, the approach would appear to have shortcomings with regard to being 'fit for purpose'.

10.2.4.11 Broker reports and the Dividend Yield approach

684. Brokers provide reports for their client base on expected future earnings, stock prices and dividend yields on a range of stocks, including for infrastructure firms.

685. A range of brokers' reports may be used to assess the overall earnings of a particular regulated firm. This so-called Dividend Yield approach is similar to the Comparable Earnings method, except that it uses regulated firms as comparators. The Dividend Yield approach – and brokers' reports more broadly – were considered by the Authority in 2010 as part of its decisions on the Western Australian Gas Networks (**WAGN**) and Dampier Bunbury Natural Gas Pipeline access arrangements. The estimate was developed by SFG Consulting.[304]

686. First, SFG submitted that the expected return on equity available to investors has three possible components: (i) dividends; (ii) capital gains; and (iii) dividend imputation credits.

687. In the case of WAGN, SFG Consulting used research reports from various brokers to estimate the average dividend yield for a sample of firms which were considered comparable to WAGN.[305] This was added to estimates of capital gains and the benefits from dividend imputation credits to derive an overall return on equity for the comparable firms.

688. However, while forecasters have been reluctant to evaluate their own performances, there exists evidence to suggest that the record of economic forecasting is not encouraging.[306] Additionally, the estimate of the cost of equity using the brokers' research reports involves at least three forecasts (dividend yield, inflation and GDP growth). The Authority is of the view that all series used as inputs for the brokers' forecasts exhibit a relatively high degree of volatility. As a result, the error of these estimates compounds for the estimate of the cost of equity.

689. SFG Consulting claimed that:

[304] See for example, SFG Consulting 2010, *The required return on equity commensurate with current conditions in the market for funds, Report prepared for WA Gas Networks*, www.erawa.com.au.

[305] The sample of comparable firms included a sample of firms which are considered comparable to DBP, including APA Group (APA), Hastings Diversified Utilities Fund (HDF), Envestra (ENV), Spark Infrastructure (SKI), SP Ausnet (SPN), and DUET Group (DUE).Broking houses include Macquarie Bank, UBS, Wilson HTM, Morgan Stanley, Credit Suisse, Ballieu Research, Goldman Sachs JBWere, JP Morgan, RBS Morgans, Merrill Lynch.

[306] For example, see Fildes, R. and Makridakis, S. (1995). The impact of empirical accuracy studies on time series analysis and forecasting, *International Statistical Review,* 63, 3, 289-308; and Hendry, D. and Clements, M. (2003). Economic forecasting: some lessons from recent research, *Economic Modelling,* 20, 301-329.

- estimating the cost of equity using the Dividend Yield technique does not require any other input assumptions other than the brokers' estimates of the dividend yield;[307] and
- even if an individual analyst does suffer from an optimism bias, the same bias is present in his or her forecasts and target price and, as such, using the earnings forecasts of equity analysts is appropriate to estimate the cost of equity.[308]

690. The Authority considers that the first argument by SFG Consulting runs counter to the fact that Dividend Yield approaches are based on analysts' views with regards to dividend cash flows and stock prices. As noted at paragraphs 654 to 656 above, these estimates are subjective. The estimates vary significantly across equity analysts and across time.

691. With regard to the second argument, the Authority does not consider that using broker target stock prices will necessarily offset broker bias with regard to dividend cash flows (refer to paragraph 657 above). SFG Consulting makes this claim but provides no supporting evidence. It is not clear to the Authority as to whether the bias applies equally to dividends or target stock price. It is possible that the bias applies only to dividends, and hence to the return on equity.

692. Given the poor record of economic forecasting on which the brokers' research reports are based, the Authority is of the view that it is inappropriate to use brokers' reports or the Dividend Yield approach to derive an estimated cost of equity. These approaches are not 'based on a strong theoretical foundation'. A major issue relates to the transparency and reproducibility of the broker analysis, which suggests that such an approach is not conducted 'in accordance with best practice'. Overall, the Authority does not consider that these methods are 'fit for purpose' for determining the return on equity.

10.2.5 A single or multiple model approach?

693. The conclusion from the assessment above leads the Authority to consider that the Sharpe-Lintner CAPM is the best model for assessing the return on equity. Other models and approaches are found to be not 'fit for purpose' within the Australian context, at least without some new developments in the theoretical foundations or in the empirical evidence within the Australian context.

694. The Authority does not expect it likely that there are significant new developments over the course of the life of these Guidelines; the Authority expects to be able to rely on these Guidelines in making its decisions over the next three years. However, the Authority recognises that further development of models or empirical support may arise at some future point. In this event, service providers may present significant new evidence that would cause the Authority to review its position.

307 SFG Consulting 2011, *The required return on equity commensurate with prevailing conditions in the market for funds: Response to Draft Decision*, Report prepared for DBP, www.erawa.com.au, pp. 19.

308 SFG Consulting 2010, *The required return on equity commensurate with current conditions in the market for funds: Response to BHP Billiton submission*, Report prepared for DBP, www.erawa.com.au, pp. 3-4.

10.2.6 Reasonableness checks

695. A range of approaches provide a check of the reasonableness of the estimate of the return on equity. Some of these overlap with the approaches considered above, particularly those based on broker reports. In what follows, the following approaches are considered as a basis for reasonableness checks:

- asset sales information;
- share trading multiples;
- broker estimates;
- decisions by other regulators, including from overseas;
- the relationship between the return on equity and the return on debt
- financeability and credit metrics; and
- other possible sources of information.

10.2.6.1 Asset sales information

696. Asset sales information may give some indication of the whether the overall return set by the regulator is reasonable. However, there is acceptance that sales prices need to offer some premium to induce investors to sell, such that sales prices will tend to exceed the book value of the regulatory base. This has been the common observance in recent times.[309]

697. However, the Authority considers that such a comparison provides only a rough guide as to reasonableness, as there are many factors that influence the degree to which sales prices might exceed the regulated asset base. For example, a purchaser may consider that it is able to apply higher gearing than the benchmark assumption, without increasing the cost of debt. This would drive up the expected return to equity.

698. Overall, the Authority considers that asset sales may be considered as a reasonableness check. If a clear trend emerged of discounting of the value of the regulated asset base in sales, then the Authority would need to review whether the rate of return was adequate.

10.2.6.2 Trading multiples

699. Trading multiples are reflected in the ratio of the share price valuation of the firm as compared to the book value of the regulatory asset base. As with asset sales values, it would be remiss to attribute too much precision to the results. For example, share prices for energy infrastructure have been at all time highs in recent times as a preference by investors for higher yielding defensive stocks has become widespread.

700. Again, some judgment would be required before trading multiples could signal an issue with the rate of return. Nevertheless, sustained trading multiples below one, across the economic cycle, could give a warning that rates of return were not in line with market expectations.

[309] See for example, Australian Energy Regulatory 2013, *Final decision: SPI Networks (Gas) Pty Ltd access arrangement, Part 3: Appendices*, p. 60.

10.2.6.3 Brokers' estimates

701. Issues relating to the utility of brokers' reports were considered at paragraphs 688 to 692 above. The Authority has significant concerns with regards to the use of brokers' reports, given potential for bias, and the lack of transparency. Nevertheless, the Authority considers that brokers' estimates do provide some relevant information for reasonableness checks, where those reports are transparent, and where a range of different views can be obtained.

10.2.6.4 Decisions by other regulators

702. The Authority has in past decisions taken account of the views of other regulators in Australia in setting rate of return parameters, and in checking the reasonableness of overall outcomes for the rate of return.

703. While there is some potential for circularity, the Authority considers that such comparisons should be made on merits. That is, it is useful to explore the reasons for any underlying similarities or differences, and to consider whether these are warranted.

704. In this context, it may also be valuable to look at decisions of regulators overseas. While these may not align with the domestic boundary adopted by the Authority, they may be useful in some instances. For example, treatment of risks by an overseas regulator for assets that are similar in characteristic to the reference service may be insightful in informing the Authority's consideration of such issues.

705. Overall, the Authority expects to continue to use the decisions of other regulators to check outcomes from its own decisions.

10.2.6.5 Relationship between the return on equity and the return on debt

706. The Authority considers that in general, the return on equity should exceed the return on debt, given that equity is more risky than debt. Provided that the two are compared on a consistent basis, then the condition should hold

707. However, it is not possible to be definitive about the extent to which this difference between the two returns could be. The Authority is of the view that the difference between the return on debt and return on equity may not be constant through time. In a particular market condition, the return on equity may be significantly higher than the return on debt and vice versa. As such, the Authority considers that it is appropriate to use the reasonableness check to ensure that estimates of return on debt and return on equity are reasonable in the prevailing market conditions at the time the regulatory decisions are made.

10.2.6.6 Other information

708. The Major Energy Users suggested that reasonable checks should be made of the regulated rate of return with reference to rates of return:[310]

- observable in the wider market; and
- of the service provider over time.

[310] Major Energy Users Inc. 2013, *Submission*, www.erawa.com.au, p. 33.

709. With regard to this suggestion the Authority considers that the first point is an implicit outcome in the CAPM. However, as noted earlier in this chapter, the CAPM model estimates the ex ante requirement for the rate of return. It is entirely consistent then that actual outcomes for the rate of return on equity may differ from the regulated rate of return at any given point in time.

710. In addition, there may be issues related to composition, as most infrastructure assets are owned within a company with a number of different assets, including non-regulated assets.

711. Overall, the Authority does not consider that such reasonableness checks are likely to be of value.

10.3 Draft Guidelines

712. The Authority considers that the Sharpe-Lintner CAPM is the only model for determining the return on equity that meets its criteria for acceptability in the Australian context, at the current time.

11 Market risk premium

713. The market risk premium (**MRP**) is the required return, over and above the risk free rate of return, on a fully diversified portfolio of assets. The MRP, a key component of the estimate of the required rate of return on equity, compensates an investor for the systematic risk of investing in the "market" portfolio. Total risk for any business includes systematic risk and non-systematic risk. Systematic risk cannot be diversified away by investors because this type of risk affects all firms in the market.

714. The required rate of return determined by Australian economic regulators for future regulatory periods (generally periods of 5 years) is a forward-looking concept. As such, any input in the estimation cannot be observed. Estimates of the risk-free rate of return and cost of debt are relatively robust due to returns being directly observable on debt instruments. Conversely, there is no directly observable proxy for the MRP as returns on equity instruments, with respect to cash flows and timing, are generally not written into contracts. Furthermore, the actual return realised on these instruments over any given period may not necessarily reflect the return investors expected when making investment decisions. It is the expected return that is of more importance when pricing capital in order to efficiently attract investment.

715. As a consequence, Australian economic regulators agree that the estimate of the MRP should be derived from various sources where reasonable data is available. Also, as the MRP is a forward-looking concept subject to high levels of uncertainty in the short term, it is assumed expectations will be developed on the long term observations and thus are relatively stable over time. Investors are not expected to change their long-term expectation of the MRP as frequently as daily changes in the financial markets. An important issue is the extent to which MRP estimates be permitted to fluctuate across periods. Australian regulatory practice has typically applied a long term average MRP of 6 per cent over the past decade.

716. An additional issue that has arisen as a result of using long-term estimates of the MRP being employed in the rate of return is the consistency between risk-free rates used in the cost of debt and CAPM, and that used to estimate the MRP. Given that the risk-free rate of return can be directly observed on proxies for risk-free assets and that current rates are considered more reflective of future rates than historical rates, regulators often use this rate in combination with the long-term average MRP.

11.1 Authority's current approach to estimating the market risk premium

717. A wide range of different approaches have been adopted by Australian regulators in determining an appropriate estimate of the long-term forward-looking MRP for the Australian financial market.

718. For example, in its previous decisions, the Authority considered a wide range of evidence for the long-term and forward-looking estimates of the MRP, including:

- an estimate of the historical equity risk premium over the longest possible period;

- surveys of market risk practice;
- qualitative information on Australian financial markets around the time of the decisions; and
- other Australian regulators' current practice.

11.1.1 Historical average of equity risk premium

719. The first consideration for the appropriate estimate of the MRP is historical data on equity risk premium. However, this approach is based on the view that past experience will provide an indication of future expectations. The approach has gained support for being transparent, extensively studied and the results are well understood.

720. In their 2012 study, Dimson, Marsh and Staunton concluded that the historical average approach remains the most relevant approach for estimating the MRP as there are no better forecasting methods available:[311]

721. In summary, there are good reasons to expect the equity premium to vary over time. Market volatility clearly fluctuates, and investors' risk aversion also varies over time. However, these effects are likely to be brief. Sharply lower (or higher) stock prices may have an impact on immediate returns, but the effect on long-term performance will be diluted. Moreover volatility does not usually stay at abnormally high levels for long, and investor sentiment is also mean reverting. For practical purposes, we conclude that for forecasting the long run equity premium, it is hard to improve on extrapolation from the longest history that is available at the time the forecast is being made.

722. The next consideration is whether an estimate of the MRP using historical data on equity risk premium is biased and, if such a bias exists, whether the resulting estimate is biased upwards or downwards. It is noted that there are views explaining certain upwards biases compared with the true long-term forward-looking MRP.

723. McKenzie and Partington;[312] Damodoran[313] are of the view that an estimate of the MRP using historical average of the equity risk premium is likely to overestimate the true expectation due to the presence of survivorship bias. In this method of deriving an estimate for the MRP, a national stock exchange index is used as a proxy for the market equity return. For example, in Australia, a proxy for the equity market return is the Australian All Ordinaries Index. These authors argued that stocks with consistently negative returns, and as such are no longer in the market, have been excluded from the relevant stock market index such as the Australian All Ordinaries Index.

724. Siegel (1999) considers that historical equity returns are likely to overstate returns actually realised and earned because of historically high transaction costs and the

[311] Dimson, Marsh and Staunton, *Credit Suisse Global Investment Returns Sourcebook 2012*, February 2012, p.37.

[312] McKenzie, M. and G. Partington, *Equity market risk premium*, 21 December 2011, pp. 6–7

[313] Damodoran, A. *Equity risk premiums: determinants, estimation and implications—the 2012 edition,* Mach 2012, p. 24.

historical lack of low cost opportunities for diversification.[314] As such, the long-term forward-looking MRP is expected to be lower over time.

725. Brailsford, Handley and Maheswaran (2008) in the Australian context, acknowledged that historical estimates have traditionally been used in cost of capital of the equity risk premium have traditionally been used in asset evaluation and continue to be used. Using a more comprehensive data set than previous studies they found estimates that were substantially lower. This was attributed to lower estimated stock returns prior to 1958, and to a lower extent, higher bill returns prior to 1960.[315]

726. In conclusion, the above analyses indicate that the long-term average of the historical data on equity risk premium, being the difference between the return on equity and the return on the risk-free asset, can be used as a proxy for a forward-looking estimate of the MRP. In addition, various studies have also confirmed that there may be an overestimate of the true long-term forward-looking MRP when the historical data on equity risk premium is used.

11.1.2 Various surveys of market risk practice

727. Various surveys of market risk practice have been used to derive estimates of the forward-looking MRP. The Authority considers that outcomes from surveys should be used with caution because of the following possible issues: (i) the number of respondents to the surveys is not representative, (ii) the questions being asked in the surveys; and (iii) the timing of the surveys. In addition, complementary to the above issues, outcomes from the surveys may be subjective due to sampling issues. In addition, there is generally no specific time horizon associated with the questions asked in surveys.

728. However, the Authority and other Australian economic regulators have consistently considered a wide range of available surveys when assessing the long-term forward-looking MRP for the Australian financial market. In addition, it is acknowledged that by considering a wide range of surveys, this practice will limit possible biases because surveys are conducted with different respondents in various industries at various points in time.

11.1.3 The Authority's previous decisions

729. In its previous decisions, such as the 2012 Western Power Access Arrangement, the Authority outlined its view that an estimate of the MRP using historical data on equity premia over a long period of time was appropriate as a forward looking estimate. This decision was based on the view that investors will consider premiums over a long time period in the past to approximate future premia.

730. The Authority maintains its view that using historical data on risk premium to derive a proxy for the forward-looking MRP is appropriate. The Authority considers that there is no robust evidence suggesting that there has been a sustained structural break in the economy causing a permanent and significant shift in the expectations of investors.

[314] Lally, *Cost of equity and the MRP*, July 2012, p. 8

[315] Brailsford , Handley and Maheswaran (2008), *Re-examination of the Historical Equity Risk Premium in Australia*, Accounting and Finance, Vol.48, p.95.

731. In its previous regulatory decisions, the Authority considered the prevailing conditions in the market for funds at the time the decisions were made. At the time of these decisions, no robust and convincing evidence had been identified to support a view that the market had shifted to a different level such that the estimates of the MRP should be different.

11.1.4 References to other Australian regulators' decisions

732. The Authority agrees that there may be circularity in forming the view of an appropriate estimate of the MRP when decisions by other Australian regulators are referenced. However, Australian regulators have made their decisions at various points in time and they have also considered wide ranging evidence in forming their view on the value of the MRP.

733. In addition, taking account of decisions by other Australian regulators has helped to ensure that new pieces of information have been considered in the respective decision making processes. These references have also ensured that Australian regulatory decisions have achieved predictability and stability.

11.1.5 Conclusion

734. Historical data on equity risk premiums is only one input into the determination of the MRP. The Authority's current approach considers both long-term forward-looking approaches, such as surveys of market risk practices and historical averages of the equity risk premium, together with qualitative information and evidence at the time that decisions are made.

735. Many Australian economic regulators have adopted 6 per cent in recent decisions. These are presented in Table 14 below.

11.2 Summary of submissions

736. In the Authority's Consultation Paper, *Guidelines for the Rate of Return for Gas Transmission and Distribution Networks,* published on 21 December 2012, the Authority sought submissions from stakeholders on the estimates and methodology for deriving a market risk premium.

737. *First*, Wesfarmers Chemicals, Energy & Fertilisers submitted that given the MRP changes over time and that a 5-year term assumption is used for the risk-free rate, a shorter time period over which the MRP is assessed should be considered for consistency with the term of the risk-free rate.[316]

738. *Second*, the Major Energy Users Inc (**MEU**) submitted that the long term MRP does not reflect short term variations in financial markets.[317] An analysis provided by the MEU indicates that the actual MRP has been zero or negative for much of the time since 2010. This estimate of the MRP was based on 10-year Commonwealth Government Securities and the Australian Stock Exchange accumulation index. MEU also argued that the Australian Stock Exchange accumulation index was not representative of the wider economy and that the risk premium is not representative of the specific features of network investment. The

[316] Wesfarmers Chemicals, Energy & Fertilisers, *Rate of Return Guidelines Review,* 28 Feb 2013, p.2

[317] Major Energy Users Inc, *AER guideline on Rate of Return, Response to Issues Paper,* February 2013, p.22

MEU is concerned that the index is an overstatement of the actual performance of the market due to unsuccessful firms being eliminated from the index.[318]

Table 14 The estimated value of the market risk premium in the Australian regulatory decisions

Regulator	Year	Industry	MRP (Per cent)
ACCC[319]	2011	Fixed Line Services (Telecommunications)	6.00%
AER[320]	2012	Gas Distribution Network	6.00%
ERA[321]	2012	Electricity Distribution/Transmission	6.00%
ERA[322]	2011	Gas Transmission	6.00%
IPART[323]	2012	Water, sewerage, stormwater drainage and other services	6.00%
QCA[324]	2012	Water, sewerage, stormwater drainage and other services	6.00%
ESCOSA[325]	2012	Water, sewerage, stormwater drainage and other services	6.00%

Source: Compiled by the Economic Regulation Authority

739. *Third*, Goldfields Gas Transmission (**GGT**) submitted that the relationship between the MRP and market volatility should be considered in any model which is adopted to derive an estimate of a return on equity. GGT's view is primarily based on its references to the Brattle Group's report and the Competition Economics Group (**CEG**)'s analysis in relation to the relationship between the MRP and risk free rate/market volatility.[326] Details of these reports are discussed in turn below.

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318 Major Energy Users Inc, *AER guideline on Rate of Return, Response to Issues Paper,* February 2013, p.23

319 Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 61

320 Australian Energy Regulator, *Access Arrangement final decision Envestra Ltd 2013-17 Part 1,* March 2013, p. 30

321 Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012

322 Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p.158

323 Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p.183

324 Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 485

325 Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p.9

326 Brattle Group, *Estimating the Cost of Equity for Regulated Companies*, February 2013, p. 60; Goldfields Gas Transmission Pty Ltd, *Submission to Economic regulation Authority Consultation Paper: Guidelines for the Rate of Return for Gas Transmission and Distribution Networks*, 28 Feb 2013. pp. 14-17; Competition

740. In its submission, CEG claimed inconsistency between the AER's (and thus indirectly the Authority's) MRP and the risk-free rate estimate. CEG is of the view that the inconsistency arose from the spot risk free rate being used as a forward looking long term forecast while MRP was something other than a 'spot' rate. As such, CEG submitted that the risk-free rate used in the estimation of the MRP and risk-free rate added in the CAPM equation need to be the same for the CAPM to be valid.[327] Their claim in relation to inconsistency between the risk-free rate of return (being the spot rate) and the estimate of the MRP via the risk-free rate (being the historical rate) can be expressed as below.

$$R_i = RF_{current} + \beta_i (RM_{historic} - RF_{historic}) \qquad (11)$$

741. CEG also argued that current Australian regulatory practice indicates that the spot risk free rate is subject to fluctuations which are reflected in the cost of capital estimate (being the first component of the above equation) while the variations in the spot yield on equities are rejected (being the second component of the above equation). In addition, CEG was of the view that the combination of the volatile risk free spot rate (the first component of the above equation) with a stable historical MRP (the second component of the above equation) provides no natural hedge to businesses to compensate for their exposure to volatility. CEG argued that stability in total returns is more valuable than stability in individual components of the return.[328]

742. Based on their arguments, CEG submitted that a long term average estimate for *both* the risk-free rate and MRP *or* prevailing actual spot rates for *both* of these parameters should be adopted in regulatory decisions in order to achieve internal consistency. They advocated the use of the former, using a 10-year historical average.[329]

743. *Fourth*, another expert's evidence submitted by GGT comes from Professor Alan Gregory's analysis. Professor Gregory's view is that an approach combining an historical MRP with a current spot rate of the risk free rate is inappropriate. CEG highlighted Gregory's view that an allowance should be made for any possible inverse relationship that exists.

744. Professor Gregory claims that combining an MRP that is derived from historical observations with a current spot rate is an inconsistent approach when no allowance is made for any possible inverse relationship between the risk free rate and MRP.[330] Professor Gregory argued that UK regulators and IPART make allowances for this possible relationship.[331]

745. Professor Gregory also argued that the following two possible approaches were identified which were believed to achieve consistency.

Economics Group, Update to March 2012 Report on Consistency of the Risk Free Rate and MRP in the CAPM, November 2012, p. 15

[327] Competition Economists Group, *Response to AER Vic Gas Draft Decisions: Internal Consistency of MRP and Risk Free Rate*, November 2012, pp.10-11

[328] Competition Economists Group, *Response to AER Vic Gas Draft Decisions: Internal Consistency of MRP and Risk Free Rate*, November 2012, p.20

[329] Competition Economists Group, *Response to AER Vic Gas Draft Decisions: Internal Consistency of MRP and Risk Free Rate*, November 2012, pp.16-17

[330] Gregory, A, *The AER Approach to Establishing the Cost of Equity – Analysis of the Method Used to Establish the Risk Free Rate and the Market Risk Premium*, November 2012, p. 3.

[331] Ibid, pp. 17-18

746. The first possibility is to estimate directly a forward looking *expected* market return and (spot) risk free rate. This approach is consistent with an approach recommended to the UK regulators in Smithers & Co's 2003 report. In that report, GGT submitted a report from Professor Gregory who referred to Smithers & Co's 2003 observation, the historical market return itself is more stable than the MRP in the UK context. Professor Gregory concluded that if the mean of the market return is more stable than the MRP, direct estimates of the expected market return are likely to be more statistically reliable than estimates consisting of the summation of the risk free rate and MRP.[332]

747. The second possibility is to use long term historical averages of the risk free rate in combination with the long term average MRP. Professor Gregory noted that this approach may be difficult because estimating the forward looking risk free rate in current market conditions is difficult.[333]

748. *Fifth*, in relation to the approaches that can be adopted to estimate the MRP, the Authority has received proposals from service providers and their consultants in the previous proposed access arrangements to adopt: (i) the "implied volatility" approach/model; and (ii) the dividend growth model. In addition, the Authority has also received proposals suggesting that the required rate of return should be determined as a package. These proposals are in response to the problems, as claimed by regulated businesses, arising from using the Sharpe-Lintner CAPM to determine the return on equity.

11.3 Considerations of the Authority

749. Public submissions from regulated businesses and their consultants, as previously summarised, can be grouped into three key areas as below.

750. *First*, there is inconsistency in the approach to determining the MRP and the risk-free rate of return. Regulated businesses were of the view that the MRP is estimated based on historical data of equity risk premiums whereas a risk free rate is derived using the "on-the-day" approach, being the last 20 trading days period prior to the release of the regulatory decisions.

751. *Second*, regulated utilities have argued that the risk-free rate of return is at an historical low due to a flight to quality in the Australian financial market.

752. *Third*, regulated businesses have also considered that it is more appropriate to adopt a constant return on equity in regulatory decisions. They have argued that a constant return on equity is due to a negative correlation between the risk-free rate and the MRP. As such, from their argument, a reduction in the risk-free rate will be offset by a relative increase in the MRP.

753. Based on the above arguments, regulated businesses have proposed the following two options to overcome existing issues in the estimate of a return on equity: (i) estimating a risk free rate by adopting long-term historical data instead of using a 20 trading day period; or (ii) revising upwards an estimate of the MRP by adopting "spot" MRP to offset any reduction in the risk free rate.

[332] Ibid, pp. 19-20

[333] Ibid, p. 20

754. In assessing these three key and fundamental issues, the Authority is of the view that both theoretical and practical considerations are required.

11.3.1 Theoretical considerations

755. The key concern raised by regulated businesses is that the MRP and risk free rate of return are negatively correlated. As such, any reduction in the risk free rate of return is offset by an increase in the MRP, leaving the estimate of a return on equity unchanged.

756. The Authority will consider this argument by revisiting the framework of the Sharpe-Lintner CAPM, which has been adopted to estimate the return on equity for regulated businesses, and will examine some interpretations of how this model can be consistently used in the context of a low risk free rate.

11.3.1.1 A modern portfolio theory – a static theory

757. Modern portfolio theory (**MPT**) seeks to determine how a rational investor will allocate capital between various securities. By combining stocks in a portfolio, MPT demonstrates that investors can achieve superior levels of expected return by taking on a given level of risk than that which could be achieved by holding individual stocks. In addition, MPT also assumes that investors can borrow and lend their capital at the risk free rate. In this context, MPT assumes that an optimal portfolio exists, to be called the *market portfolio*, which maximises the expected return per unit of risk. Investors then determine the proportion of capital they allocate between a risk-free asset and the optimal market portfolio, which is risky, through their preference for risk.

758. Formally, an investor is presented with a universe of stocks that are assumed to be random variables. Each stock is therefore assumed to have a probability distribution, with the mean of the distribution determining the expected return of the stock and the variance of the probability distribution determining the level of risk. In addition, each stock is assumed to be related to all others via the correlation between itself and the other stocks in the portfolio. In this situation, the expected return and variance of a portfolio of n stocks can be summarised as below:

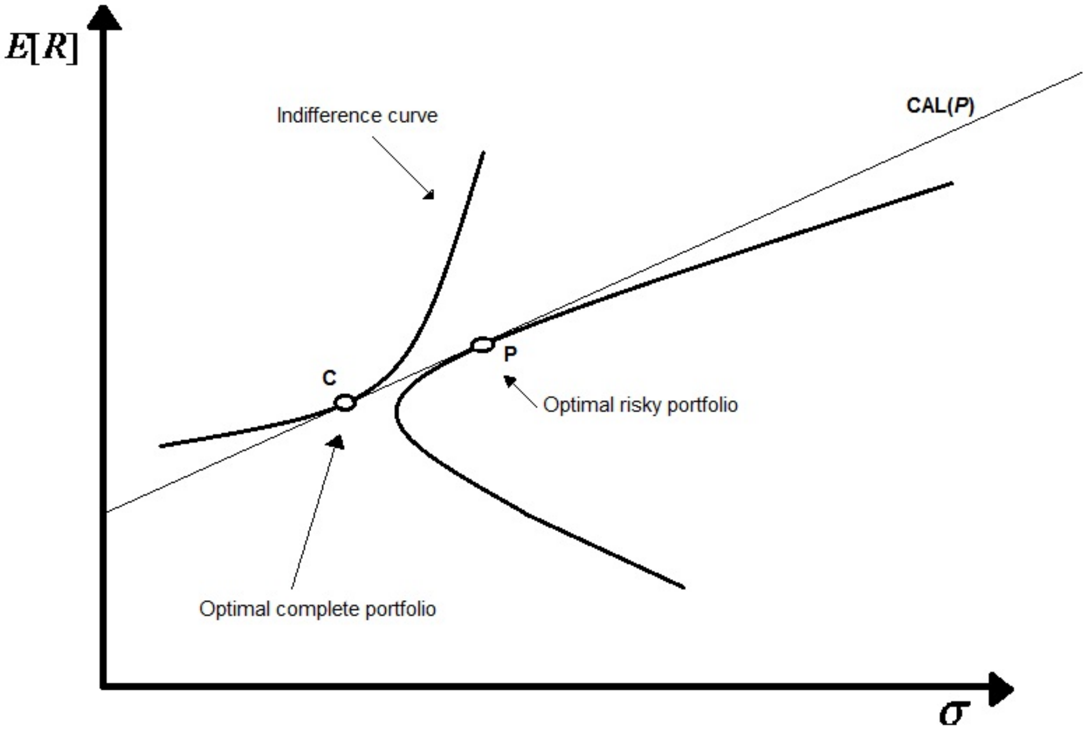
$$E[R] = \sum_{i=1}^{n} w_i \mathrm{x} E[r_i] \tag{12}$$

$$\sigma_p^2 = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j \neq i}^{n} w_i w_j \sigma_i \sigma_j \rho_{ij} \tag{13}$$

759. Investors seek to maximise the expected return per unit of risk, or $\frac{E[R]}{\sigma_p}$. For a given level of a risk, the maximum expected return is calculated by choosing the portfolio weights which maximise the expected return per unit of risk ratio, which is $\frac{E[R]}{\sigma_p}$. By varying the level of risk and performing this optimisation, an “efficient frontier” of portfolios can be constructed which achieve the optimum expected return for a given level of risk.

760. This model is then extended further by allowing for the existence of a risk-free asset. In this context, capital can be allocated to the risk-free asset such as Commonwealth government securities, together with a portfolio of stocks. Alternatively, capital can be borrowed at the risk-free rate and then invested in a portfolio of stocks. In this case, it can be shown that an *optimal* portfolio of stocks exist that has a superior expected return per unit of risk. By allocating capital between the risk-free asset and this *optimal portfolio*, the superior expected return per unit of risk ratio can be preserved. The investors desired level of risk can be achieved via this mechanism. As a consequence, all rational investors who seek to maximise the expected return per unit of risk will choose to hold a proportion of their capital in this optimal portfolio, and the remaining proportion in the risk free asset. By choosing the proportions of capital allocated between the optimal portfolio and risk-free asset, the desired level of risk can be achieved that maximises expected return.

Figure 14 Capital Allocation Line



761. A static analysis, that is, one which ignores the perpetually changing variables and their potential inter-relations, is presented in Figure 14 as a theoretical starting point for discussion that follows further on.

762. The allocation of capital between the optimal risky portfolio and the risk-free asset is shown in Figure 14 above in the Capital allocation line (**CAL**). Point P on the CAL represents the optimal portfolio that maximises the expected return per unit of risk. Given that the CAL dominates the efficient frontier of risky assets, investors are able to achieve superior risk-return combinations by investing in both the risk-free asset and the optimal portfolio. The choice of portfolio is determined by the investor's indifference curve, which represents the risk-return combinations that give the investor the same level of utility. A rational investor will attain the highest indifference curve possible, representing the highest level of utility possible from investing. Therefore, an investor will allocate their capital at Point C above, where the highest possible indifference curve is tangent to the capital market line.

763. The *optimal* portfolio is known as the *market* portfolio as this portfolio must contain all risky assets. Given that diversification reduces the unsystematic risk of the portfolio, only systematic risk remains in a diversified portfolio. It is assumed that diversification is costless, and as a consequence, return is only achieved by bearing systematic risk. The optimal portfolio will therefore only compensate investors for bearing systematic risk, as unsystematic risk is costless to diversify away. As systematic risk is market risk, the fully diversified portfolio will contain only macroeconomic risks, and as a consequence investors will only earn a return for bearing macroeconomic risks.

764. From the above analysis, the return of an individual security is related to the covariance the security has with the returns of the market portfolio. As investors earn no return for bearing unsystematic risk, it follows that the return of an individual security will be related to the degree of systematic risk inherent in the security. The covariance between the market portfolio and the individual security represents the degree of systematic risk presented in the individual security. The sensitivity between a security and the market is referred to as a beta, β and this beta represents the degree of systematic risk present in a security.

765. The expected return of the risk-free asset corresponds to an asset having a beta of zero because a risk-free asset faces no systematic risk. The return of the market portfolio as a whole corresponds to a beta of 1, as by definition the market portfolio is the benchmark for systematic risk. Assuming that the return of an individual asset is linearly related to its β, these 2 points can be used to construct the Security Market Line (**SML**) as follows:

$$SML: E[R_i] = R_f + \beta_i (E[R_m] - R_f) \tag{14}$$

where:

$E[R_i]$ is the expected return of security i;

R_f is the risk free rate of return;

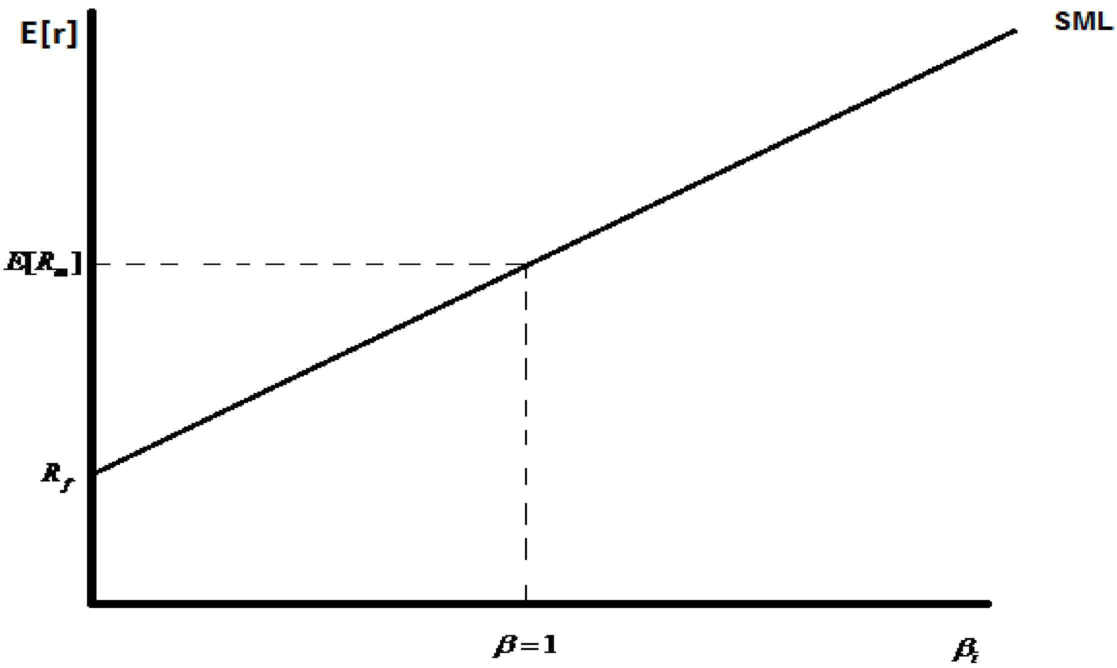
β_i is a measure of the systematic risk present in security i; and

$E[R_m]$ is the expected market return.

766. The SML differs from the CAL in that it considers the measure of systematic risk present in security *i* as the determinant of its expected return, whereas the CAL considers its risk more generally as the determinant.

767. The difference between the expected return for security *i* and a risk-free rate of return, $E[R_m] - R_f$, is generally referred to as the market risk premium (**MRP**). The MRP represents the premium investors earn over and above the risk-free rate of return for bearing systematic risk. This situation can be represented graphically showing the relationship between a securities expected return $E[R_i]$ and a security's β. As a result, the intercept represents the risk-free rate of return, whilst the slope of the SML is the market risk premium. The SML representation is also known as the Sharpe-Lintner CAPM.

Figure 15 Security Market Line



768. It can be shown that a security β is determined by the following equation:

$$\beta_i = \frac{Cov(i, Mkt)}{\sigma_m^2} \tag{15}$$

where

$Cov(i, Mkt)$ is the covariance of security i with the market portfolio, σ_m^2 is the variance of the market portfolio.

769. A more detailed summary of a modern portfolio theory can be found in Appendix 12.

770. The following section sets out possible explanations in which this static model can change over time (to be called *dynamic scenarios*) in response to a reduction in the risk-free rate.

11.3.1.2 Modern portfolio theory – Dynamic scenarios

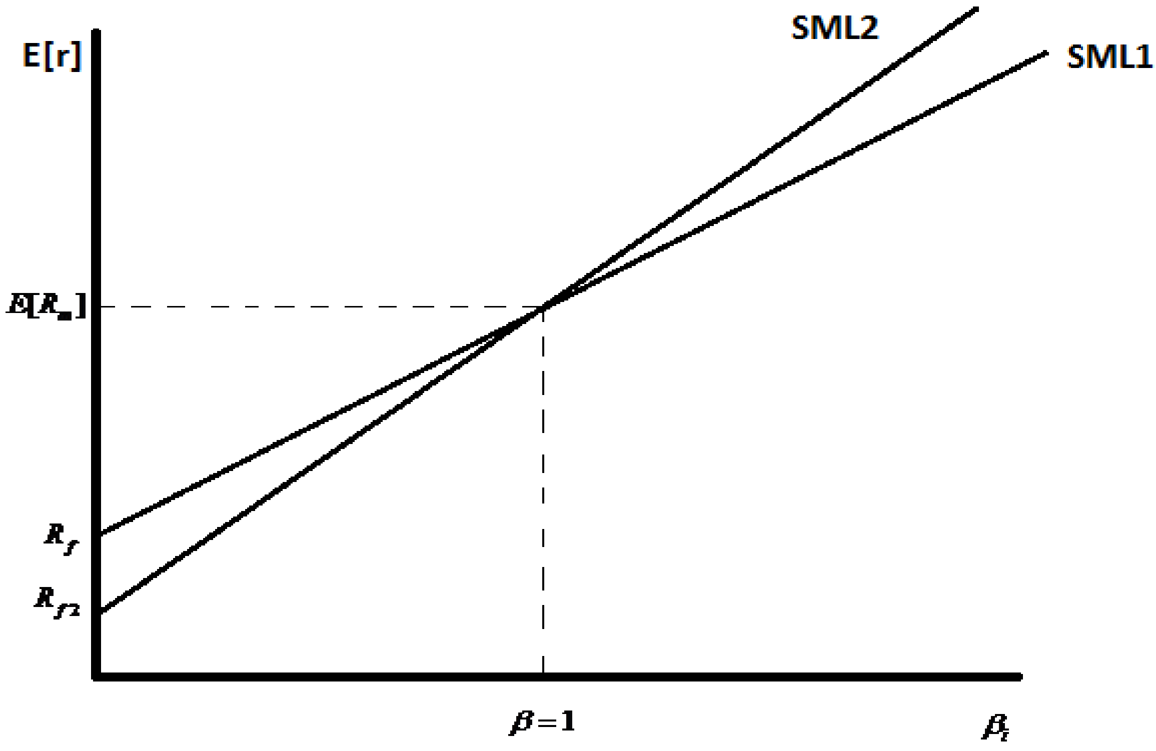
771. The Authority has considered three different dynamic scenarios to be applied to the static model set out above, stemming from a reduction in the risk-free rate of return:

- a reduction of a risk-free rate is associated with an increase in the MRP, *Scenario 1*
- a reduction of a risk-free rate is not associated with any change in the MRP, *Scenario 2*
- a reduction of a risk-free rate is associated with a decrease in the MRP, *Scenario 3*

Scenario 1: A reduction in a risk-free rate of return results in an increase in the MRP

772. An inverse relationship between the risk-free rate of return and the MRP will occur when there is a pivot of a SML around the market portfolio for which the beta is 1. Figure 16 presents that, when the risk-free rate of return decreases from R_f to R_{f2}, then the slope of the SML increases which is represented for an increase in the MRP. As a result, the Authority is of the view that, in theory, there may be merit in the view of there being an inverse relationship between the risk-free rate and the MRP.

Figure 16 An inverse relationship between a risk-free rate and a MRP



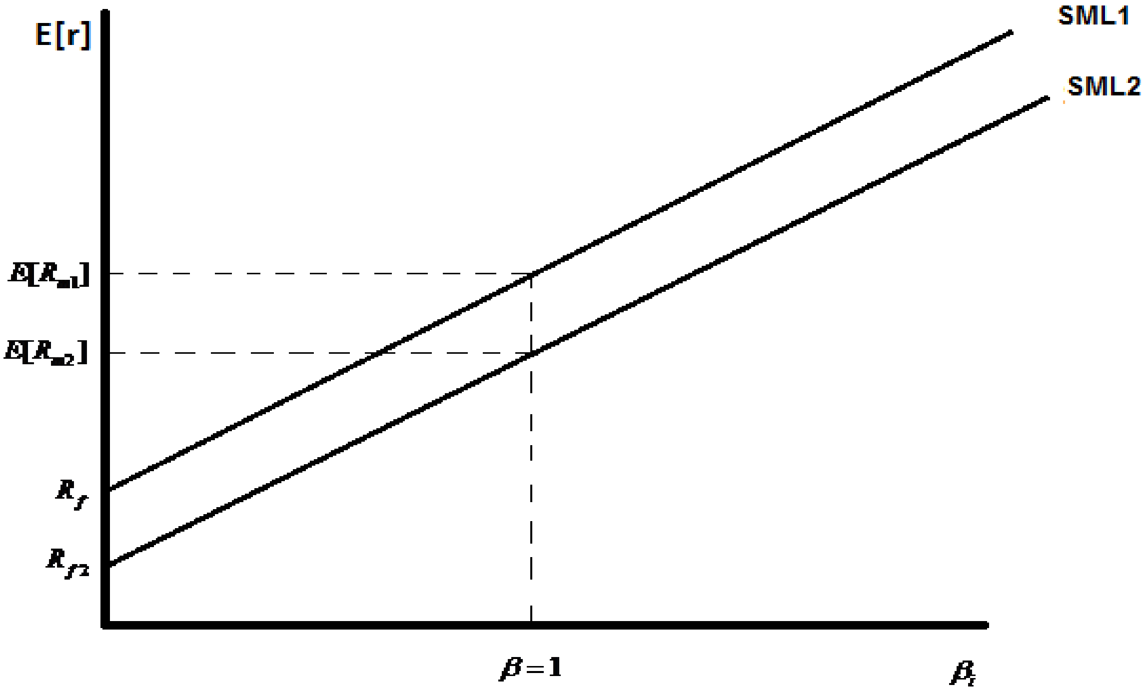
Source: Economic Regulation Authority's analysis

Scenario 2: A reduction in a risk-free rate of return leaves the MRP unchanged

773. The second scenario, as presented in Figure 17 below, illustrates for a paralleled shift downwards of the SML, from the SML_1 to SML_2, in response to a reduction of the risk-free rate of return from R_f to R_{f2}. In this scenario, the slope of the SML remains unchanged, which represents for an unchanged MRP, after a reduction in the risk-free rate.

774. The Authority is of the view that, theoretically, *Scenario 2* is also a possible relationship between the risk-free rate of return and the MRP.

Figure 17 A reduction of a risk-free rate is associated with an unchanged MRP



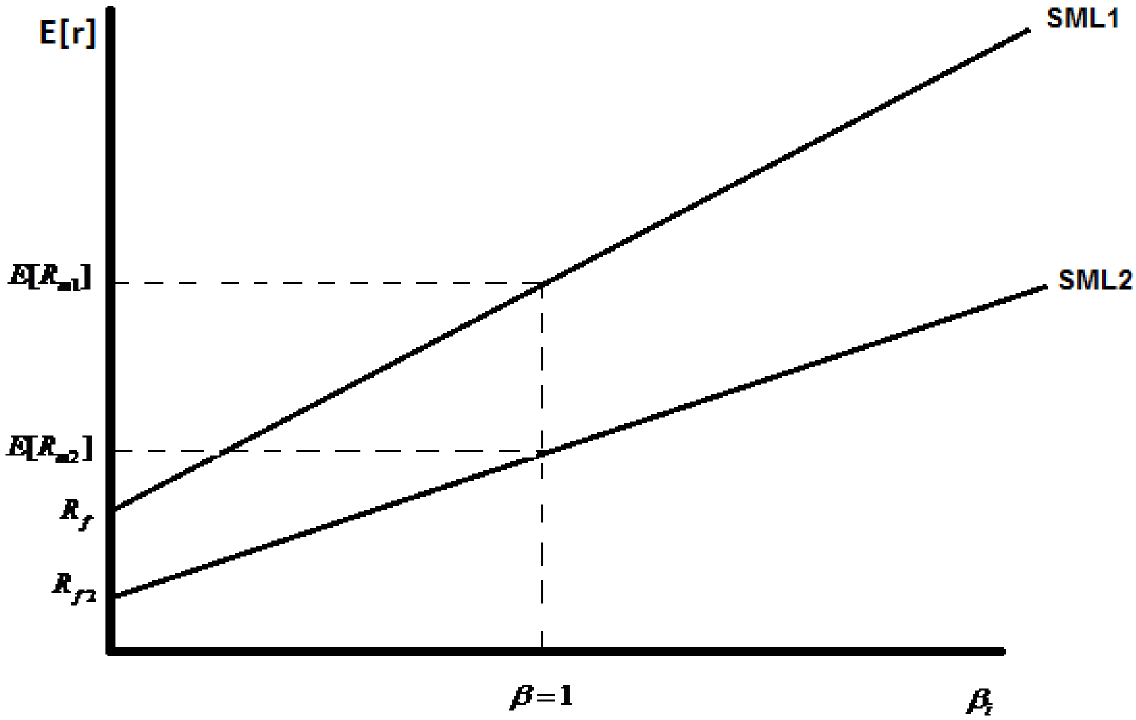
Source: Economic Regulation Authority's analysis

Scenario 3: A reduction in a risk-free rate of return results in a reduction in the MRP

775. It is also possible that the SML shifts downwards in response to a reduction of the risk-free rate of return. However, this shift does not take place in parallel. It means that the slope of the new SML, SML_2, is flatter in comparison with the slope of the original SML, SML_1. In this case, a reduction of the risk-free rate results in a lower expected return in the market generally and a reduction of the MRP.

776. The Authority is of the view that, from a theoretical perspective *Scenario 3* is no less a possibility than *Scenario 1 and 2.*

Figure 18 A positive relationship between a risk-free rate and a MRP



Source: Economic Regulation Authority's analysis

777. In conclusion, the Authority is of the view that it is inappropriate to constrain itself to the consideration of *Scenario 1* to the exclusion of other possible relationships between the risk-free rate of return and MRP in the Australian financial market. Since theoretical considerations cannot provide the Authority with firm conclusions in relation to the relationship between the risk-free rate and MRP in the Australian financial market, the Authority considers that empirical evidence, together with data observed from the market, will help form a view on the relationship between the two parameters.

11.3.2 Practical considerations: the Authority's recent empirical studies

778. The Authority has conducted its own analyses, together with available information and evidence on the issues, in response to the following three criticisms:

779. Inconsistency between the approach of determining the risk-free rate of return and MRP where the former is based on the 'on the day' approach while the latter is based on the historical data.

780. The risk-free rate of return is at an historical low due to a flight to quality in the Australian financial market.

781. A constant as opposed to varying return on equity should be adopted on the basis that reductions in the risk-free rate will be offset by increases in the MRP due to a negative relationship between the two.

782. Each of the issues raised by regulated businesses and their consultants is responded to in turn.

783. The following analyses have been conducted by the Authority in response to the issues raised:

784. *First*, an empirical study on a flight to quality in the Australian financial market. This study aims to capture the so-called “flight to quality” in the context of Australia in which there is a movement of funds from equity markets into the Commonwealth government securities market. The purpose of this study is to provide empirical evidence on the argument that a risk-free rate of return is too low in Australia. This complete study can be found in Appendix 13.

785. *Second,* a co-integration test between the observed yields of the CGS bonds and the cash rates determined by the RBA. The purpose of this study is to provide empirical evidence to examine whether the currently observed low level of risk-free rate may be explained by another factor, the cash rate determined by the RBA. . The details of this test can be found in Appendix 14.

786. *Third,* a co-integration test between the observed yields of CGS bonds and the market risk premium which is derived as the difference between the market return and the risk-free rate of return. Regulated business submitted that the rate of return determined in regulatory decisions should be stable over time. The implication of this proposal is that any reduction in the risk free rate will be offset by a relative increase in the MRP, leaving the return on equity unchanged when the Sharpe-Lintner CAPM is adopted. In an econometric sense, this implication means that the risk free rate and the MRP should be co-integrated. In the case of the market returns and the risk free rate in the CAPM, the two series are tested to confirm whether or not they are co-integrated, in the sense that they share a long-run stochastic trend. Intuitively, the risk free rate is not expected to rise above the market returns for an extended period of time. Conversely, the market return is not expected to stay below the risk free rate for an extended period of time. One would expect a tendency for correction over the long run where the returns to investing in the market are sufficiently higher than the risk free rate to compensate for the risks inherent in equity investment. The details of this test can be found in Appendix 15.

787. *Fourth,* an updated empirical study on the Granger Causality test between the market risk premium and the risk-free rate of return. The purpose of this updated study is to investigate whether or not the currently observed low risk-free rate is caused by the market risk premium or vice versa. The Granger causality test assumes that changes in variable X cause changes in variable Y based purely on precedence within a time series. If there is a relationship between changes in X and Y, and X *precedes* Y then X *Granger causes* Y based on the assumption that the future cannot predict the past. That is, if event A occurs before event B, it is possible event A causes event B, but not vice versa. A commonly cited example of Granger causality which highlights the downfall of this assumption is that Christmas card sales precede Christmas, therefore Christmas card sales cause Christmas. The details of this empirical study can be found in Appendix 16.

11.3.2.1 Inconsistency between approaches of deriving the MRP and of estimating a risk free rate of return

788. A forward looking MRP is estimated using various approaches and one of these approaches uses historical data on equity risk premiums. In addition, the risk free rate of return is estimated using an averaging period of 20 trading days prior to the release of the regulatory decisions. The Authority has considered this issue and provided evidence supported from both theoretical and empirical grounds on

the refinancing issue, which can be found in chapter 6**.** The Authority is of the view that there is no inconsistency between approaches of estimating the MRP and the risk free rate of return in its regulatory decisions. This view is supported by other Australian regulators including the AER.

11.3.2.2 Historically low risk free rate

789. Regulated businesses and their consultants claim that a risk-free rate of return is now at a historical low. As such, the currently adopted MRP of 6 per cent is required to be revised upwards to compensate for the low level of the risk free rate.

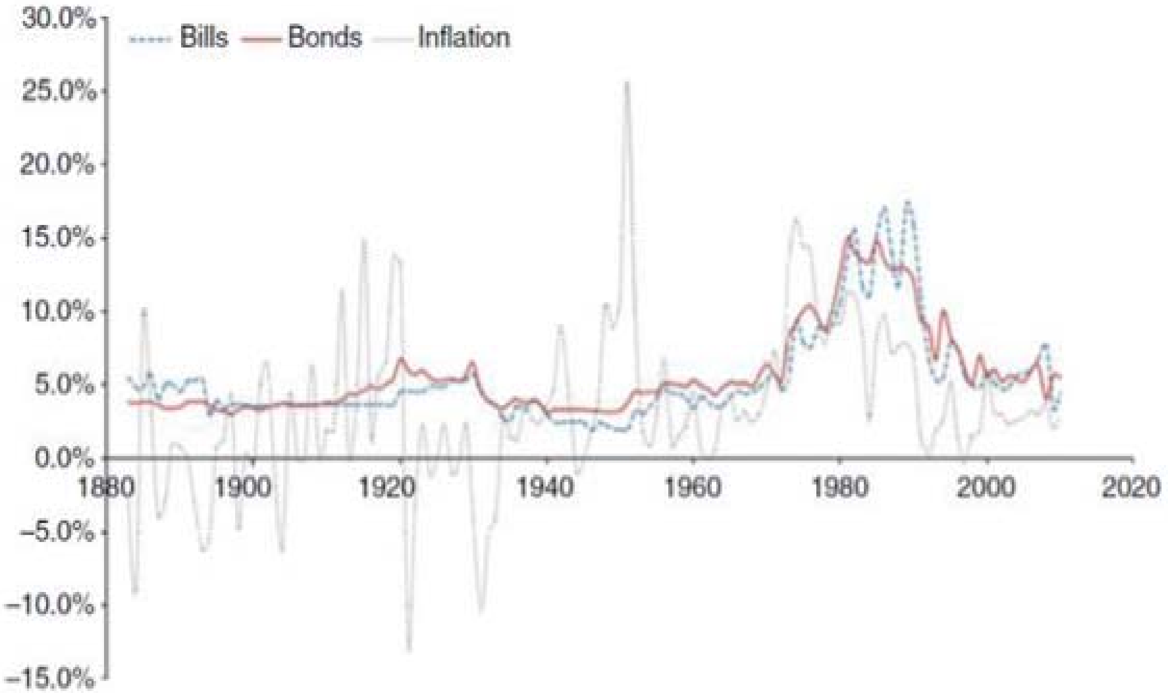
790. Making an adjustment to the MRP to compensate for a low risk-free rate would violate the integrity of each input in a determination of a required rate of return. All inputs should be independently derived from an objective and robust approach/model.

791. In relation to the current level of a risk-free rate, there are two possibilities: (i) the current level of a risk-free rate is at a historical low; or (ii) the current level of a risk-free rate reflects the mean-reversion of a risk-free rate to a low level from a very high level in the previous decades due to high expected inflation.

792. The Authority agrees with McKenzie and Partington that classifying current interest rates as being abnormally low is a relative statement. McKenzie and Partington considered that a commonly used method is to assess the current interest rate against a long history of data. They then considered the history of yields in the USA, UK and Australia with the view that the lessons provided by the USA and UK are relevant for Australia as they have a greater length of historical data of interest rates. McKenzie and Partington concluded that it is the period of high interest rates in the seventies, eighties and nineties that are the best candidate for being abnormal, rather than the current "low" rates as presented in Figure 19 below.[334]

[334] McKenzie and Partington, 2013, *Review of the AER's overall approach to the Risk free rate and Market Risk Premium,* A report to the AER, 28 February 2013, p.8.

Figure 19 Bond yields, Bill yields and Inflation rates, 1880 - 2012



Source: Brailsford et al (2012)

793. In addition, after reviewing various studies on the long historical interest rates, in both nominal and real terms, in the US, the UK, and Australia, McKenzie and Partington were of the view that the more recent history of interest rates (in the seventies, eighties and nineties) is not truly representative of the long run in this market. They also argued that evidence exists which suggests that bond yields were stable (and possibly even falling) in the long run for the US, UK and Australian markets. They considered that the more recent history is anomalous and the high interest rates observed during this period are clearly not representative of the longer time series. As such, one conclusion that may be drawn is that the current level of interest rate is a return to the 'normal' long run interest rate regime. On the other hand, they also argued that there is a new normal and the most recent global financial crisis represents a true regime shift for global financial markets. However, they acknowledged that it is difficult to determine whether this is the case or not, and that only in the fullness of time will we be able to comment on this with any certainty.[335]

794. In conclusion, the Authority is of the view that it is unclear that the current level of the risk free rate is at an historical low.

11.3.2.3 Flight to quality in the Australian financial market

795. Regulated businesses have raised concerns that the risk-free rate of return has been at a historically low level due to the so-called "flight to quality" in the Australian financial market. The Authority has conducted its own analysis to determine whether or not there is empirical evidence to support the argument that a "flight to quality" has taken place in Australia.

[335] McKenzie and Partington, 2013, *Review of the AER's overall approach to the Risk free rate and Market Risk Premium,* A report to the AER, 28 February 2013, pp.11-4.

796. A “flight to quality” is the concept that in times of uncertainty in equities markets, investors rebalance their investment portfolios toward greater proportions of assets with lower risk, in particular those found in the fixed-income markets such as Government bonds, as opposed to equities. The most common methodology in the “flight-to-quality” literature is to investigate whether there is a negative relationship between government bond prices and equity returns in order to find evidence of funds moving rapidly from a domestic equity market into domestic Government bonds.

797. Following Gulko’s methodology, a crash day is defined as a day where the market index loses five percent or more of its value.[336] The event window is defined as starting two days before this crash day and finishes ten days after this crash day. If another crash occurs between the crash day and day ten after the crash, day ten is reset to occur ten days after the latest crash. The *prologue* is the period before the event window while the *epilogue* is the period after the event window.

798. A hypothesis was developed to test the existence of the flight to quality in the Australian financial market. The hypothesis is that, if there is a flight to quality, then the observed yields on the Commonwealth Government Securities (**CGSs**) and equity returns are negatively correlated between the prologue and the epilogue and positively correlated during the crash window. This means that the equity-bond correlation switches signs from negative to positive during stock market crashes.

799. The All Ordinaries (non-accumulation) price and 10-year Australian Commonwealth Government bond yield indices were sourced from Bloomberg. Each observation represents the last trading day closing observation available. The full set of daily observations covers the period from 30 September 1983 to 25 January 2013.

800. The results from the Authority’s study suggest that, in general, there tends to be some positive co-movement between stock prices and Treasury bond yields in Australia in the *prologue* periods. On the days before a crash, it appears that the co-movement is more direct between the two markets, but this co-movement breaks down during the days surrounding a crash. In the *epilogue*, similar co-movement between the markets appears to return.

801. The findings from the Authority’s study fails to support the ‘flight-to-quality’ hypothesis as formulated by Gulko for the US market. Further details on this study can be found in Appendix 13.

802. Gulko’s analysis was carried out on the US market. The US is perceived as a ‘safe haven’ thus it may experience net capital inflows from the rest of the world into its safest assets.[337] Post 1987, the US Treasury bonds became the safe investment of choice over gold.[338] Conversely, Australia is a very small market without the reputation of the US as a safe haven during times of heightened uncertainty. A possible explanation for the above results is that the ‘flight-to-quality’ effect may see funds leaving the Australian market destined for investment in markets that are perceived as safe, such as the US market. Dungey, McKenzie and Tambakis’ 2009 study found this to be the case between

[336] Gulko L, 2002, Decoupling, *the Journal of Portfolio Management*, Vol 28, No. 3. p 60.

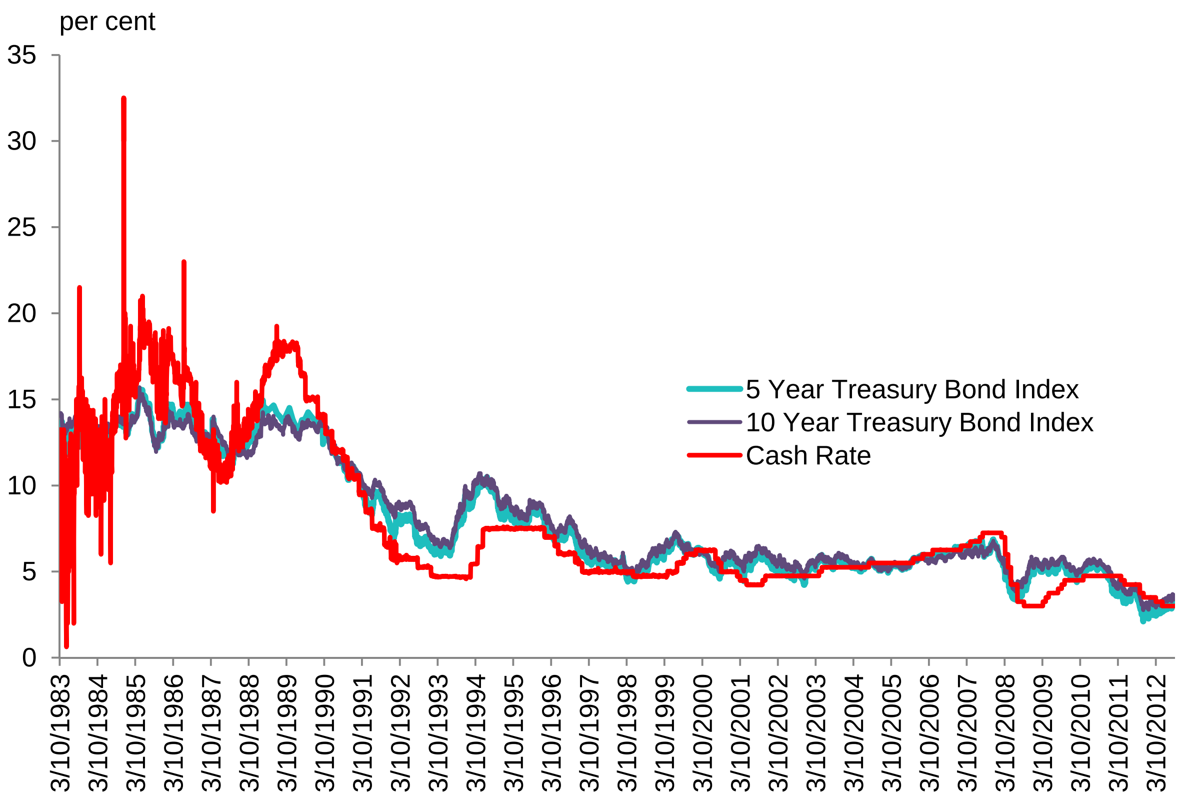
[337] Caballero and Kurlat, October 2008, Flight-to-quality and Bailouts: Policy Remarks and a Literature Review, Massachusetts Institute of Technology Department of Economics Working Paper 08-21, p.1.

[338] Gulko, 2002, Decoupling, The Journal of Portfolio Management, Vol 28, No. 3, pp.59-66

emerging equity markets and the US Treasury bond market.[339] This means that there is a flight to quality in the emerging equity markets where funds are leaving these emerging countries' financial markets to the US's Treasury bond markets.

803. The Authority notes that the currently low risk-free rate could be a result of the period of heavy intervention in the cash rate by the Reserve Bank, which is presented in Figure 20 below. Figure 20 indicates that there is a strong correlation between the cash rate level and the risk-free rate of return in the Australian context. This conclusion is confirmed by the findings from the Authority's empirical study on the co-integration between the risk-free rate of return and the RBA's cash rate. Further details on this study can be found in Appendix 14.

Figure 20 Correlation between the 5-year Treasury bond and the cash rate



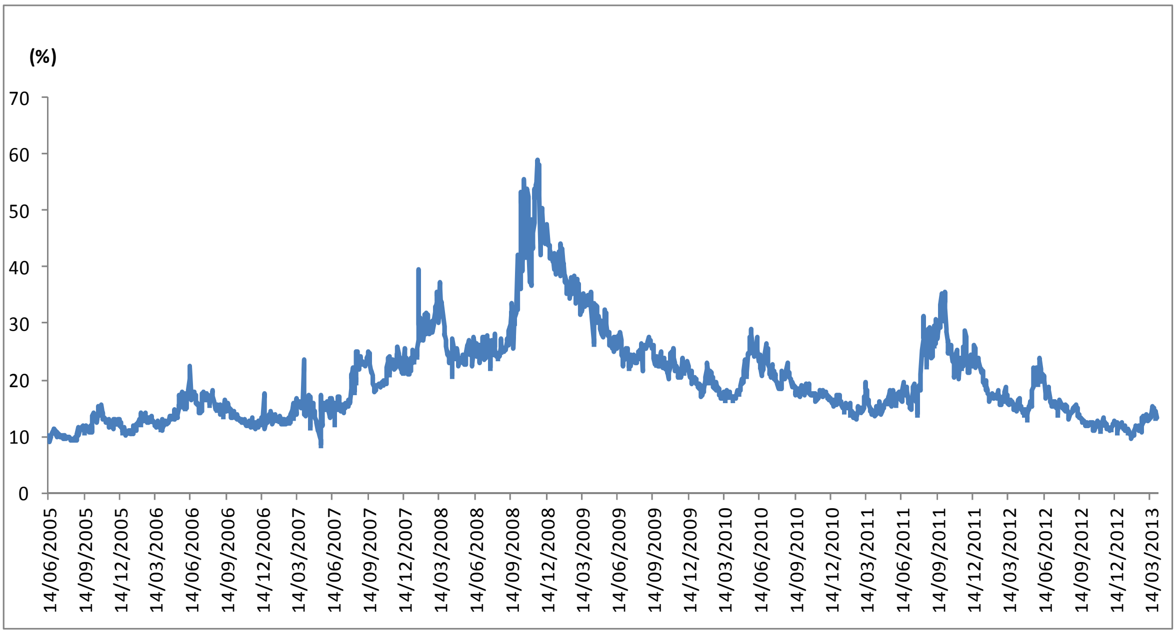
Source: RBA and Economic Regulation Authority's analysis

804. In addition, regulated businesses have also argued that a low risk-free rate is due to a "flight to quality" in the financial market. It means that the level of risk aversion has increased significantly during the "flight to quality" period. As such, they argued that the MRP should have been higher during the economic turmoil. The Authority is of the view that implied volatility observed from call options in the Australian financial market has provided evidence to the contrary. Increased volatility in financial markets is typically associated with an increased level of uncertainty and risk aversion. Volatility measures are widely implied using call option pricing formulas and market data. The volatility measure on 3 month call options has followed a declining trend since late 2008 as presented in Figure 21.

339 Dungey M, McKenzie M & Tambakis D, 2009, Flight-to-Quality and Asymmetric Volatility Responses in US Treasuries, Global Finance Journal, No. 19, pp. 252-267

This tends to indicate that the level of risk aversion has substantially decreased during the last 3 years.

Figure 21 The 3-month call implied volatility



Source: Bloomberg and Economic Regulation Authority's analysis

805. In conclusion, the Authority is of the view that there is no empirical evidence to support the view that there is a "flight to quality" in the Australian financial market during periods of economic uncertainty. A low risk-free rate could possibly be a direct result from heavy intervention of the cash rate by the central bank. In addition, the implied volatility on the call options failed to support the view that the level of risk aversion in the Australian financial market has significantly increased in recent years.

11.3.2.4 Negative correlation between the MRP and the risk free rate

806. Regulated businesses have argued that the return on equity should be stable over time. In achieving a stable return on equity, they propose that a historical average of risk-free rate should be used.

807. The Authority is of the view that, if it is assumed that the expected return on the market (or a return on equity) is stable, then by definition an inverse relationship must exist between the risk-free rate and the market risk premium. That is, when the risk-free rate is low, the MRP should be high and vice versa.

808. From the perspective of equity valuation, the price of equity (share price) is the present value of the sum of expected cash flows.[340] As such, a change in equity price may be due to the change in expected cash flow and/or the change in the discount rate. McKenzie and Partington argued that there may be times when changes in expected cash flow largely drive changes in equity values; and there may be times when changes in the cost of equity largely drive changes in equity values, and it is likely that there are times when equity values change because of changes in both the expected cash flow and the cost of equity. McKenzie and

340 Risk preferences and cash flow volatility are reflected in the discount rate used in the discounting of cash flows to equate them with the present value.

Partington are of the view that understanding the relative importance of discount rate and the expected cash flow in asset pricing is a crucial and unresolved issue.[341]

809. The argument of the inverse relationship between the risk-free rate and the MRP is identical to the view that they are co-integrated. This argument means that there is a co-movement between the risk-free rate and the MRP. The Authority has also conducted its own analysis to test this hypothesis on the co-movement between the risk-free rate and the MRP.

810. A single time series such as the yields on a bond may move in such a way that it does not revert to any long run mean or long run level of volatility. In the language of time series analysis, such a series is known as *non-stationary*. The implication is that the most recent observation in the series is the best predictor of tomorrow's value.

811. Two or more time series that exhibit such trends can at times have a stochastic trend in common. This stochastic trend is often exhibited over long periods of time. It can be the case that a linear combination of the two series produces a new stationary series, even though each series is non-stationary; that is, a series that tends to revert to some long run average and long run level of volatility. This stationary series implies that an equilibrium relationship exists between the two series. Two series that exhibit such a characteristic are referred to as *co-integrated*.

812. In the context of the market returns and the risk free rate, the two series are tested to confirm whether or not they are co-integrated. This means that the test is designed to determine whether or not these two series share some long run stochastic trend. Intuitively, the risk free rate is not expected to lie above the market returns for an extended period of time. Conversely, the market returns are not expected to stay below the risk free rate for an extended period of time. One would expect a trend for correction over the long run where the returns to investing in the market are sufficiently higher than the risk free rate to compensate for the risks inherent in equity investment.

813. The findings from this study indicate that there is no evidence to support a co-integrating relationship between the 5-year bond yield series and market return/risk premium series in both scenarios when the co-integrating coefficient is <u>and</u> is not constrained to one. In addition, there is also no evidence to support a co-integrating relationship between the 10-year bond yield series and market return/risk premium series in the scenario when the co-integrating coefficient is constrained to one. Statistically, there appears to be a co-integrating relationship between the 10-year bond yield series and the corresponding market return/risk premium series when the co-integrating coefficient (ϕ) is not constrained to one. However, the Authority is of the view that caution must be exercised in accepting the conclusion in the unconstrained analysis. This is because the estimate for the co-integrating coefficient on bond yields regressed against market returns is significantly lower than one. On the grounds of an economic theory, the estimate of -0.5778, as presented in the Authority's analysis, for the co-integrating coefficient ϕ does not make any sense from a practical perspective. This finding indicates that the MRP is the difference between the market return and some proportion of a risk-free rate of return. It is contrary to the economic theory which

[341] McKenzie and Partington, 2013, *Review of the AER's overall approach to the Risk free rate and Market Risk Premium,* A report to the AER, 28 February 2013, p.5.

states that the MRP is estimated as the difference between the market return and an entire risk-free rate.[342] Further details of the Authority's analysis can be found in Appendix 15.

814. Another updated empirical study, the causality test between the risk-free rate of return and the market risk premium, was also conducted. This updated Granger causality test suggests that changes in Australian Government bond yields *Granger cause* (as opposed to cause) changes in the market risk premium, but not vice versa. The study also indicates that bond yields and market returns appear to contain no predictive content with respect to each other. Further details of the Authority's analysis can be found in Appendix 16.

11.3.2.5 Conclusions

815. The Authority has considered a possible relationship between the risk-free rate of return and the MRP on both theoretical grounds and empirical grounds.

816. On theoretical grounds, the Authority is of the view that there are three possibilities for this relationship between the two parameters: (i) negative relationship; (ii) positive relationship and (iii) a reduction in a risk-free rate is associated with unchanged MRP.

817. On empirical grounds, the Authority's empirical studies did not support the view that any reduction in the risk-free rate is offset by an increase in the MRP. The small, open, dynamic Australian financial market is constrained by various factors, not only stocks and bonds. Empirical evidence could not support the flight to quality in the Australian financial market. The Authority is not aware of any empirical studies which indicate there is such a flight in the Australian financial market in recent periods.

818. On balance, the Authority is of the view that a scenario which indicates the possibility that a reduction of a risk-free rate of return is not associated with any move in the MRP is the most appropriate. This view is not only supported by the Authority's empirical studies, but also supported by observed data on the implied volatility, which is a proxy for a level of risk aversion in the financial market.

11.3.3 Potential alternative methods, approaches and datasets

819. In relation to the approaches that can be adopted to estimate the MRP, in the past the Authority has received proposals by service providers and their consultants to adopt: (i) the "implied volatility" approach/model; and (ii) the dividend growth model. In addition, the Authority has also received proposals suggesting that the required rate of return should be determined as a package. These proposals are in response to the problems, as claimed by regulated businesses, arising from using the Sharpe-Lintner CAPM to determine the return on equity.

820. Each of these approaches is briefly discussed below.

[342] Stock J and Watson, 2007, *Introduction to Econometrics*, Pearson Education, Boston MA, p.661

11.3.3.1 The “implied volatility” approach

The Proposal

821. This approach has not been proposed by any regulated businesses and its consultants in this round of public submissions. However, the approach has been proposed in the past.

822. Value Advisor Associates (**VAA**) proposed to adopt the so-called “implied volatility” approach to derive the long-term forward-looking MRP. VAA was of the view that the availability of a forward view of the market risk though the implied volatility of options on the stock market index can be used for such a purpose.

823. VAA argued that a view of market risk or volatility, which it uses to justify the use of the implied volatility, can be derived from trades in options on the ASX 200 Index. This is because a key determinant of the price of these options is a view of the volatility of the market. Given observations of the price of an option, the implied volatility can be derived as the only unknown variable in the Black-Scholes call option pricing relationship. By construction, it is therefore a forward-looking estimate of the risk of the market.[343]

824. From its analysis, VAA concluded that there has been a strong relationship between forward looking measures of risk (being the implied volatility derived from the option price of a three month option on the index) and backward looking measures of risk (being the annualised 30-day moving average of the standard deviation of the ASX 200 Index). In addition, VAA argued that a strong historical relationship between market return and risk can also be found. As a result, VAA proposes that a forward looking MRP can be derived from the historical volatility measures of the market.[344]

825. In its submissions on behalf of Western Australia Gas Networks (now ATCO Gas) in September 2010, when deriving a forward MRP from implied volatility, VAA assumed a constant required rate of return per unit of risk, and applied this to the forward view of risk assessed from the implied volatility. It is noted that the estimate of MRP from implied volatility will have the same term (i.e. time horizon) with the underlying options (in this case, 3-month call options). Deriving the MRP using this method implies that the MRP is the product between the constant price of risk and its implied volatility (the “volume” of risk).

826. VAA’s estimates revealed that the unit price of risk implicit in empirical estimates of the parameters of CAPM is about 50 basis points[345] (i.e. a 7 per cent MRP with an annual average standard deviation of 14 per cent implies 50 basis points per unit of risk). This estimate of the unit price of risk of 50 basis points is then applied to the prevailing implied volatility at that time. The implied MRP was 12.2 per cent (being equal to 24.4 per cent *multiplied by* 50 bps) where the implied volatility of the 12-month call option was 24.4 per cent over a period of 21 days to 30 November 2009.[346]

827. In conclusion, when assessing the forward view of volatility implicit in the pricing of options on the ASX 200 Index, VAA estimated that a forward-looking MRP of 8

343 WAGN’s Access Arrangement: Supporting document from Value Advisor Associates (VAA), p. 12.
344 Ibid. pp. 14-6.
345 Ibid. p. 16.
346 Ibid, p. 6.

per cent would reflect "average" prevailing market expectations over the relevant regulatory period of 5 years from 2011 to 2015. VAA stated that, in its estimates, MRP was derived as a compound average of its estimate of the spot MRP (as at November 2009) of 12 per cent and a transition to the long term average of 7 per cent over the period from 2011 to 2015.[347]

The Authority's consideration

828. The Authority did not accept VAA's proposal to use a forward-looking MRP of 7 per cent for the access arrangement of 5 years for WAGN from 2011 to 2015. Further details for this decision can be found in the Authority's Final Decision released in February 2010. One of the key reasons for the Authority to reject the proposal was that the MRP varied significantly in the estimate, from 12 per cent in 2009 decreasing to 7 per cent in 2010 and stayed unchanged for the next five years from 2011. The Authority was not convinced that such a dramatic change is suitable for the long-term forward-looking MRP. As such, in that decision, the Authority exercised its discretion by considering various sources of evidence and came to the conclusion that the long-term forward-looking MRP of 6 per cent was appropriate.

829. The Authority is aware that the historical implied volatility on 12-month call options in the Australian financial market has moderated since 2010 and the current level is below the long-term average. Figure 21 above presents the 12-month call implied volatility over the period when the data is available.

830. The Authority has recalculated the historical implied volatility on the 12-month call option for each month commencing in November 2009 and ending in March 2013, as was the approach adopted in VAA's analysis. This was done to determine the estimated MRP before applying the "sliding path" technique proposed by the VAA.

831. The average of 12-month call implied volatility for the entire period is 19.84 per cent. The level of implied volatility from 2012 and 2013 is well below this average level. In addition, the prevailing (or starting) estimated MRP varied significantly across monthly averages of the implied volatility. This fluctuation in the estimate of the MRP is not desirable as it is unlikely to reflect a long-term forward-looking MRP for the Australian financial market. For example, the monthly average of the implied volatility on 12-month call options has fallen to 14.19 per cent in March 2013, a reduction of almost 50 per cent from November 2009 levels when the VAA conducted this exercise.

832. In conclusion, the implied volatility approach has failed in the robustness test and it is likely it will also fail when other periods are considered. The sliding path technique is arbitrary. This technique also lacks support on theoretical and empirical grounds. If this approach is used, the long-term forward-looking MRP will vary significantly across regulatory periods. In addition, the Authority also considers this technique as somewhat of a black box because requests made by the Authority to obtain the model have been consistently rejected. As such, the approach exhibits a lack of transparency and ability to be replicated.

[347] WAGN's Access Arrangement: Supporting document from Value Advisor Associates (VAA), p. 2.

11.3.3.2 Dividend Growth Model

The proposal

833. The proposal includes a single-stage model and a multi-stage model.

834. The single-stage model that has also been proposed for an estimate of a long-term forward-looking MRP is the Dividend Growth Model (**DGM**). The DGM is a model expressing the value of a share as the sum of the present value of future dividends where the dividends are assumed to grow at a constant rate. The DGM relates the current price of a share $\left(P_0\right)$ to the next period's dividend $\left(D_1\right)$, the required rate of return $\left(r\right)$ and the expected dividend growth in perpetuity $\left(g\right)$ as follows:

$$P_0 = \frac{D_1}{r-g} \qquad (16)$$

which can be rearranged as:

$$r = \frac{D_1}{P_0} + g \qquad (17)$$

where

D_1/P_0 is the expected annual dividend yield; and

g is the dividend growth rate which is generally assumed to be the economic growth rate (the growth rate of GDP).

835. The multi-stage model does not assume a constant growth rate and instead forecasts dividends at varying rates of growth for the near term before they eventually reach a terminal growth rate. A price is determined for the equity once the terminal growth rate is reached, which is then discounted along with the various dividends in the periods in which they occur using the general present value formula. The discount rate that equates these cash flows to the current share price is the estimated return on equity.

836. The model was put forward by the Brattle Group on behalf of APIA. It argues that the model is easy to replicate and audit and may provide useful insights into the cost of equity when risk free rates are very low and the market is volatile. The model is less sensitive to variations in the risk free rate and may be useful in the case where the future of a company looks radically different from the past, for example, due to significant structural change. This is particularly the case for the multistage model which can capture near and longer term changes. The stable nature of the utility industry lends itself to this type of analysis.

The Authority's consideration

837. The Authority considers that the DGM is likely to produce forward-looking estimates of the MRP because the inputs into the model involve forecasting. However, these estimates of MRP will vary significantly across years and the estimates are very sensitive to small changes in the assumptions made. These issues have been discussed at length in previous decisions of the Authority and the AER. Table 15 below highlights the significant variation between estimates.

Table 15 Recent Estimates of MRP using the Dividend Growth Model, Per cent

Study/Author	Date	Dividend Yield	DPS growth	Risk free rate	MRP
CEG	Mar 2012	5.68	6.60	3.77	8.52
Capital Research	Feb 2012	4.70	7.00	5.08	6.62
Capital Research	Feb 2012	5.23	7.00	5.08	7.15
Capital Research	Feb 2012	5.71	7.00	5.08	7.63
Capital Research	Mar 2012	6.29	7.00	3.73	9.56
NERA	Feb 2012	Bloomberg & IBES forecasts	5.65	3.96	7.72-7.75
NERA	Feb 2012		5.65	5.50	6.18-6.21
NERA	Mar 2012		5.65	3.99	7.69-7.72
CEG	Nov 2012	5.34	6.60	3.05	8.89
Lally	Mar 2013	5.34	A mix of long- and short-term dividend growth	3.26	5.90-8.39

Source: AER, Multinet Final Decision, Table 5.3, page 124

11.3.3.3 Conclusions

838. The Authority has considered possible alternative approaches in which the MRP can be derived. Two approaches have been considered: (i) the “Implied Volatility” approach; and (ii) the Dividend Growth Model.

839. The Authority considers that the implied volatility approach developed by the VAA is premature and not well tested. The applications of this approach in various periods of time indicate there is no robustness in the estimated MRP. This conclusion is based on a significant variation of the estimated forward looking MRP.

840. While a dividend growth model is well established in the US, data will be a problematic issue for this model to be applied in the Australian context. The Authority is of the view that applications of this model have provided a wide variation of the MRP and as such, the approach is not fit for regulatory purposes.

11.3.4 Evaluation

841. Current Australian practice indicates that the following approaches have been used to derive an estimate of the MRP: (i) an estimate of the historical equity risk premium from the longest possible period; and (ii) surveys of market risk practice. Two further approaches have also been considered - (i) qualitative information on the Australian financial markets around the time of the decisions; and (ii) other Australian regulators’ current practice – to ensure that an estimate of the MRP reflects a forward looking expectation of market risk premium.

842. Of the above approaches for deriving an estimate of the MRP, the Authority is of the view that the approach using historical data on equity risk premiums remains appropriate. This approach is based on the view that past experience will provide an indication of the future expectations and has gained support for being transparent, extensively studied and the results are well understood. The Authority considers that this approach should continue to be used in estimating the MRP for the purpose of this rate of return guidelines.

843. The Authority is aware that other approaches such as the Implied Volatility approach and the Dividend Growth Model have been proposed in the past as alternative approaches by which the MRP can be derived. The "Implied Volatility" approach was not proposed in the submissions. As such, the approach was not considered in this rate of return guidelines. With regard to the second approach, the Dividend Growth Model, the Authority agrees that the approach is developed based on sound theoretical grounds. As such, the model could be adopted in the estimate of the MRP. However, it requires many inputs to be forecasted, as previously presented. While the dividend growth model is well established in the US, data is a problematic issue for this model to be applied in the Australian context. Applications of this model have produced wide variations of the MRP and as such, the approach is not fit for regulatory purposes. The Authority considers that there have not been enough independent forecasts of the required parameters in the Australian market to date. As such, it is not possible to adopt the approach with confidence.

11.3.4.1 Relevant sampling period

844. The Authority considers that the estimate of the MRP, being the difference between the market return and the risk-free rate of return, fluctuates significantly across periods. As such, the Authority is of the view that long-term expectations of the MRP should be derived from a long-term historical data. It is possible that the MRP is negative during some 5-year periods when the equity market is in turmoil. However, over a longer period of time, the Authority is of the view that an estimate of the expected MRP using long-term historical data on the equity risk premium is appropriate.

11.3.4.2 Relationship between the risk-free rate and the MRP

845. The Authority has considered the view of there being an inverse relationship between the risk-free rate of return and the MRP on both theoretical and practical grounds. The Authority concluded that the risk-free rate and the MRP may have an inverse or a positive relationship in theory. However, the Authority's practical considerations have failed to confirm that an inverse relationship between these two parameters has been established in the Australian context.

11.4 Draft Guidelines

846. The Authority is of the view that it is appropriate to consider various sources of evidence to derive a forward looking MRP. The Authority will consider four different approaches to derive an estimate of the MRP. These four approaches include:

- historical data on equity risk premium;
- surveys of market risk practice;

- qualitative information on the Australian financial markets around the time of the decisions; and
- other Australian regulators’ current practice on the estimate of the MRP.

12 Equity beta

847. The central implication of the capital asset pricing model (**CAPM**) is that the contribution of an asset to the systematic risk of a portfolio of assets (also known as beta risk) is the correct measure of the asset's risk and the only systematic determinant of the asset's return. There are two main components of the CAPM: (i) the market portfolio M, and (ii) beta risk β of a portfolio, which correlates the asset portfolio to the rise and fall of the market.

848. Under the CAPM model, the total risk of an asset can be divided into systematic and non-systematic risk. Systematic risk is a function of broad macroeconomic factors (such as interest rates) that affect all assets and cannot be eliminated by diversification of the businesses asset portfolio. In contrast, non-systematic risk relates to the attributes of a particular asset, where this risk can be managed by portfolio diversification.

849. The most common formulation of the CAPM directly estimates the required return on the equity share of an asset as a linear function of the risk free rate plus a component to reflect the risk premium that investors would require over the risk free rate:

$$R_e = R_f + \beta_e \left(R_m - R_f \right) \tag{18}$$

where

R_e is the required rate of return on equity;

R_f is the risk-free rate;

β_e is the equity beta that describes how a particular portfolio i will follow the market which is defined as;

$\beta_e = \operatorname{cov}\left(r_i, r_M\right) / \operatorname{var}\left(r_M\right)$; and

$\left(R_m - R_f\right)$ is the market risk premium, MRP.

850. In the CAPM, the equity beta value is a scaling factor applied to the market risk premium to reflect the relative risk to equity funds in the particular firm or activity in question.

851. Two types of risks are generally considered to determine a value of equity beta for a particular firm: (i) the type of business that the firm operates; and (ii) the amount of financial leverage (gearing) employed by the firm.

852. Australian regulated businesses and their consultants generally agree that the business activities of regulated businesses have less systematic risk than average. However, they also have argued that these regulated businesses have much higher financial leverage, and therefore higher financial risk, than the average firm (given average gearing of 60 per cent for regulated businesses versus gearing of 30 per cent for the average firm). They consider that the two effects operate in different directions and that there is no compelling a priori reason to suggest which of these effects should dominate the other. As such, they have proposed that the appropriate a priori expectation is that the equity beta for these regulated businesses is no different from that of the average firm, which is 1.0.

853. The Authority notes that higher levels of financial leverage are possible for network businesses because of their stable cash flows. The Authority also notes that there is some evidence to suggest that higher leverage provides a signal for investors as to the stability of cash flows and the overall viability of the network businesses.[348]

854. Overall, the Authority considers that the lower cash flow risk of regulated businesses results in a lower equity beta compared with the market, even with the observed higher gearing levels. The Authority does not agree that the appropriate a priori expectation of the equity beta for transmission and distribution businesses is at the market level of one.

855. In ascribing a value to the equity beta, the Authority believes that primary reliance should be placed on statistical estimates of beta values for comparable businesses that are obtained empirically where available.

12.1 Current Approaches to Estimating Equity Beta

856. Henry's 2009 study on the estimate of equity beta for regulated businesses is the first study of its kind in Australia.[349] In 2011, the Authority replicated Henry's study using the same method but with an updated data set. In 2013, the Authority conducted another study with the purpose of estimating an equity beta for Australian regulated businesses using another updated data set (containing data to April 2013). In addition, the 2013 study contains some new econometric techniques. Each of these studies, namely Henry's 2009 study and the Authority's studies in 2011 and 2013 are discussed below.

12.1.1 Associate Professor Henry's study in 2009

857. In its 2009 WACC review for electricity transmission and distribution network service providers, the AER, with the assistance of Associate Professor Henry of the University of Melbourne, established a sample of Australian businesses, comprising gas-only network businesses, one electricity-only network business, network businesses active in both electricity and gas, and general utility businesses. Given the limitations of available Australian data, the AER considered that gas network businesses could be considered as reasonable but not perfect comparators to electricity network businesses, given that both industries involve the transportation of energy.[350]

858. Based on empirical work by Henry, the AER concluded that a reasonable range of the equity beta for a gas or electricity distribution network was between 0.4 and 0.7. The AER also considered the need for regulatory certainty. Its final decision was to adopt a conservative approach to the estimation the equity beta that was commensurate with prevailing market conditions and the risks involved in

[348] Klein L.S., O'Brien T.J. and Peters S.R. 2002, Debt vs. Equity and Asymmetric Information: A review, *The Financial Review* 37, pp. 317-350.

[349] Henry, O (2009) "Estimation Beta",Advice Submitted to the Australian Competition and Consumer Commission.

[350] The sample consisted of: AGL (2002 to 2005); Alinta (2002 and 2007); Alinta Network Holdings Pty Ltd (2003 to 2006); Country Energy (2002 to 2006); Diversified Utility and Energy Trusts (2003 to 2008); ElectraNet Pty Ltd (2002 to 2008); Energy Australia (2002 to 2006); Envestra Ltd (2002 to 2008); Ergon Energy Corporation (2002 to 2008); ETSA Utilities (2002 to 2008); GasNet Australia (Operations) Pty Ltd (2002 to 2007); Integral Energy (2002 to 2006); SP AusNet Group (2006 to 2008), and SPI PowerNet Pty Ltd (2002 to 2005).

providing reference services. On this basis, the AER considered that a value of 0.8 provided the best estimate of the equity beta for gas and electricity transmission and distribution networks.[351]

12.1.2 The Authority's study in 2011

859. The Authority has conducted its own analysis with regard to the estimates of the equity beta. In 2011, the Authority used the same approach that was adopted by Henry but used an updated data set (which included data up to October 2011).

860. All data for the Authority's application of Henry's study was sourced from Bloomberg. Data was collected on both a monthly and weekly sampling frequency. Henry advised that sampling the data at a weekly frequency is a reasonable compromise of the trade-off between the noisy nature of daily data and too few monthly observations to produce reliable estimates of beta. Consistent with Henry's approach, the Authority adopted both ordinary least squares (**OLS**) and Least Absolute Deviations (**LAD**) methods in its 2011 study.

861. The Authority's 2011 empirical study was conducted in two stages.

- first, using a shorter dataset from 2002 to 2008 to be consistent with the period used in Henry's 2008 study; and
- second, using an updated dataset from 2002 to 2011.

862. The main objective of the first stage of the Authority's empirical study were: (i) to make a "like for like" comparison with Henry's results across this period, and (ii) to omit the effect of events associated with the Global Financial Crisis which occurred post September 2008. The estimated betas from the Authority's 2011 study are not statistically different from Henry's 2009 estimates.

863. When the updated data set was used, the Authority noted that the weekly sample had 15 of the 18 estimates of equity beta that were not statistically different from Henry's estimates. The differences of the remaining 3 equity beta estimates between Henry 2009's study and the Authority 2011's study using the extended dataset include: (i) the beta estimate for Envestra (**ENV**) when both OLS and LAD methods were used; and (ii) the beta estimate for SKI using the LAD method at the five per cent level of confidence.

864. In conclusion, the Authority's analysis, using the extended dataset to October 2011, can be summarised as below:

- the estimates of the equity beta using monthly data range from 0.0675 to 0.9688, with a mean of 0.4569 and median of 0.4253; and
- the estimates of the equity beta using weekly data range from 0.2168 to 1.3378, with a mean of 0.5204 and median of 0.4261.

865. Given the results from both Henry's 2009 study and the Authority's 2011 study, the Authority, in the previous access arrangement for Western Power in 2012, maintained its decision with regard to the estimates of the equity beta of between 0.5 and 0.8.

[351] See for example: Australian Energy Regulator 2009-10, Final decision: WACC review, May 2009; or Powerlink Transmission determination, 2012-13 to 2016-17 (Draft Decision, 29 November 2011, p. 33).

866. The Authority was of the view that the point estimate of the equity beta of 0.65, being the average of the lower and upper bounds of the range adopted in 2009, was reasonable for the draft and final decisions on Western Power's Access Arrangement in 2012 for the following reasons:

- the estimated equity beta of 0.65 falls in the range of the estimates that came from the empirical studies by Henry in 2009, which produced the range of 0.4 and 0.7; and by the Authority in 2011, which produced the range of 0.5 and 0.8; and
- the midpoints are taken to reduce the undesired effects of outliers, such that their effect is averaged out.

867. Table 16 contains a summary of the adopted equity beta from recent Australian regulatory decisions. Australian economic regulators have adopted values of equity beta for regulated businesses within the range of 0.55 and 0.80.

Table 16 Estimates of Equity Beta adopted by Australian Regulators

Regulator	Year	Equity beta
ACCC[352]	2011	0.7
AER[353]	2012	0.8
ERA[354][355]	2012	0.65/0.8
IPART[356]	2012	0.6-0.8
QCA[357]	2012	0.55
ESCOSA[358]	2012	0.8

Source: Compiled by the Economic Regulation Authority

12.2 Summary of Submissions

868. Submissions were received from ATCO, the Australian Pipeline Industry Association (**APIA**), and DBP on the issues related to the estimates of equity beta.

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[352] Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 49.

[353] Australian Energy Regulator, *Access Arrangement Information for the ACT, Queanbeyan and Palerang gas distribution network*, 1 July 2010 – 30 June 2015 p. 12.

[354] Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

[355] Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p. 158.

[356] Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p. 197.

[357] Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 498.

[358] Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p. 49.

869. In their submission on the Capital Asset Pricing Model (**CAPM**), the National Economic Research Associates (**NERA**), on behalf of ATCO, suggested that only the beta term has the "law of large numbers" properties. This implies that that beta is the only stable parameter in the CAPM model. NERA also submitted that betas published by investment analyst houses (such as Merrill Lynch) have adopted an adjustment procedure which adjusts the "raw" betas toward 1.0. NERA also noted that the "adjusted" betas have been used by North American regulators when they utilise CAPM in their regulatory decisions.[359]

870. In its submission to the Authority's consultation paper on the rate of return guidelines, ATCO submitted that estimates of equity beta are not required to be addressed in the rate of return guidelines. Instead, ATCO was of the view that the estimates of equity beta are to be addressed by service providers in future access arrangement proposals and that the Authority is required to assess those proposals.[360]

871. In his submission on behalf of the Australian Pipeline Industry Association (**APIA**), Professor Stewart Myers suggested that beta can be estimated from past rate of return for individual stocks and for the stock market as a whole. Professor Myers was of the view that betas estimated from portfolios rather than individual stocks would improve the accuracy of the estimates. He submitted that a portfolio beta is more reliable than an average of betas for the individual stocks. Professor Myers also outlined the imprecision in estimating equity beta, suggesting that the true beta estimate could lie anywhere within a given confidence interval, not just the midpoint.[361]

872. In addition, in their submission on behalf of APIA, the Brattle group submitted that as beta estimates rely on historical data, there may be a delay in incorporating changes in systematic risk and are therefore inherently backward-looking.[362]

873. In its submission to the Authority, DBP noted that any equity beta estimate must be applied consistently across different financial models.[363]

12.3 Considerations of the Authority

874. The Authority considers that the above public submissions can be divided into three different groups: (i) the adjustment of estimated beta; (ii) the backward-looking estimated beta; and (iii) the adoption of estimated beta from a range of estimated values. Each of these groups of submissions is discussed in turn below.

[359] National Economic Research Associates, Inc, *The Source of the Fair Rate of Return for Investor-Owned Utilities in North America: the Applicability of those Methods for Jurisdictions in Australia*, 28 Feb 2013.

[360] ATCO Gas Australia, *Response to ERA consultation paper on rate of return guidelines*, 28 Feb 2013.

[361] Myers S.C. *Estimating the Cost of Equity: Introduction and Overview*, A report prepared for Australian Pipeline Industry Association, 17 Feb 2013.

[362] The Brattle Group, *Estimating the Cost of Equity for Regulated Companies*, A report prepared for Australian Pipeline Industry Association, 17 Feb 2013.

[363] DBP, *Response to the ERA's Consultation Paper: Guidelines for the Rate of return of Gas Transmission and Distribution Networks*, Attachment 3, 17 Feb 2013 p. 13.

12.3.1 The adjustment of equity beta towards 1.0 – the market equity beta

875. The Authority does not agree with NERA's submission that an estimated beta should be adjusted toward the market equity beta of 1. The Authority notes that a typical adjustment to the raw beta is the Blume adjustment. The Blume adjustment applies a weight of 0.67 to the raw beta estimate and a weight of 0.33 to the average beta estimate of 1.0. This reflects the belief that there is a tendency for equity betas to approach one over time, reflecting management tendency to diversify their firms over time. However, the AER rejected this adjustment in its WACC review in 2009 on the basis that the adjustment is arbitrary.

876. The Sharpe-Lintner CAPM estimates the risk premiums based on the non-diversifiable (systematic) risk. Additionally, the regulated rate of return only applies to regulated assets and not necessarily those acquired as part of a diversified portfolio. The equity beta as a measure of non-diversifiable risk therefore, is estimated only with respect to regulated assets and not the entire portfolio. The Authority is of the view that there is no convincing evidence for this adjustment and NERA has not provided any evidence to substantiate its proposal.

877. The Authority agrees that there is a high level of imprecision of beta estimates using empirical studies. However, the Authority considers estimating equity beta using historical data on the stock prices approach is a very common approach. The issue of imprecision of the estimates is best addressed via the use of multiple models and techniques so that a wide range of estimates can be considered.

12.3.2 The backward-looking estimated beta

878. The Authority notes that there is no *a priori* expectation of an appropriate value of equity beta for regulated gas businesses in Australia. As such, the Authority is of the view that estimating equity beta using empirical studies is appropriate. The AER adopted this approach in its WACC 2009 Review.

879. The Authority agrees that the return on equity derived from the Sharpe-Lintner CAPM is a forward looking concept. However, empirical studies using historical data to estimating its input parameters does not mean that the estimates are backward looking. Professor Myers agrees with this point.[364] Given no forecast is feasible for estimating an equity beta of a firm, the Authority considers that it is appropriate to estimate equity beta using historical data on share prices.

12.3.3 The determined beta from a range of estimates

880. In his submission, Professor Myers submitted that beta can be estimated from past rate of return for individual stocks and for the stock market as a whole. Professor Myers was of the view that betas estimated from portfolios rather than individual stocks would improve the accuracy of the estimates. He submitted that a portfolio beta is more reliable than an average of betas for the individual stocks.

881. The Authority agrees with Professor Myers' view on the issue. In addition, on the ground of Associate Professor Henry's advice to the AER in 2009, the Authority

[364] Myers S.C. *Estimating the Cost of Equity: Introduction and Overview*, A report prepared for Australian Pipeline Industry Association, 17 Feb 2013.

considered that estimated equity betas using weekly data is preferred to those estimated using monthly data.

12.3.4 Estimating Equity Beta: Authority's enhanced study in 2013

882. The Authority's empirical study in 2011 utilised the two methods that were used in Henry's 2009 study: the ordinary least squares (**OLS**) and the Least Absolute Deviations (**LAD**) methods and the data set was ended in 2011. In this enhanced empirical study in 2013, the data set is extended until April 2013. In addition, in this new study, together with the traditional OLS and LAD methods, the following two methods are added: (i) the MM methodology, and (ii) the Theil-Sen methodology. Detailed discussions on these methods are provided in Appendix 17.

12.3.4.1 Introduction

883. It is a convention that beta is generally estimated by using a regression analysis expressed by the following equation:

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \varepsilon_{i,t} \tag{19}$$

where

β_i is the equity beta for asset i;

r_{it} is the observed raw returns to asset i in year t;

r_{mt} is the observed market returns in year t;

α_i is a constant specific to asset i; and

ε_{it} are the residuals.

12.3.4.2 Data

884. Table 17 below presents sample of companies and data period from the Authority's empirical study in 2013. Description of business activities of these companies are provided in Appendix 5.

Table 17 Sample of companies and data period from the Authority's 2013 study

Name	Bloomberg's ticker	From	To
Envestra	ENV	14/12/2001	19/04/2013
APA Group	APA	14/12/2001	19/04/2013
GasNet Australian Group	GAS	21/12/2001	17/11/2006
Alinta Limited	AAN	14/12/2001	17/08/2007
Jemena	AGL	14/12/2001	13/10/2006
DUET Group	DUE	20/08/2004	19/04/2013
Hastings Diversified Utilities Funds	HDF	17/12/2004	23/11/2012
SP Ausnet	SPN	23/12/2005	19/04/2013
Spark Infrastructure Group	SKI	16/12/2005	19/04/2013
All ordinary Index	AS30	4/01/2002	19/04/2013

Source: Bloomberg

885. GasNet Australian Group, Alinta Limited, and Jemena are excluded from the sample because, unlike the other companies, the three excluded companies do not have data available until 2013. As a result, the sample only has 6 companies.

886. Price data used was the last price for all stocks provided by the Australian Stock Exchange (**ASX**). The price reporting settings in Bloomberg were described in Appendix 19.

887. Dividend data used in the study was gross dividends including cash distributions, but omitting unusual items such as stock distributions and rights offerings. The dividend was then added to the closing price on the Friday after the ex-dividend dates as this is the first day the price would reflect the payout of the dividend in the data.

888. For the All Ordinaries index, which represents a return for the entire Australian stock market, the gross last dividend per share was used which includes the net dividend and any tax credit where applicable.

889. No adjustments were made to historical volume in Bloomberg. Only some adjustments were made to be consistent with Bloomberg's reporting of data. Further details can be found in Appendix 19.

890. It is noted that net debt information for the six firms in the sample is the sum of *short* and long-term borrowings less cash and near cash items, marketable securities and collaterals. In addition, market capitalisation for the six firms was measured as the current monetary value of all outstanding shares stated in the pricing currency.

12.3.4.3 Construction of Returns

891. Returns in CAPM regressions are usually based on continuously compounded returns which are presented in equation (2) below. Both the AER[365] and Henry found no evidence that β estimates obtained from discretely compounded data, as presented in equation (3), are manifestly different from those obtained from continuously compounded data.

$$r_{i,t}^{c} = \ln\left[(p_{i,t-1} + d_{i,t}) / p_{i,t-1}\right] \qquad (20)$$

$$r_{i,t}^{d} = \frac{p_{i,t} - p_{i,t-1} + d_{i,t}}{p_{i,t-1}} \qquad (21)$$

where

$r_{i,t}^{c}$ is the continuously compounded return for asset i in day t; taking into account dividend d;

$r_{i,t}^{d}$ is the discretely compounded return for asset i in day t; taking into account dividend d;

p_{it} is the price of asset i in day t; and

d_{it} is the dividend payout to asset i on day t.

12.3.4.4 Analysis

892. All regression results, associated standard errors and test statistics, were computed using R 2.13.2 open source software. All equity betas in the following analysis are de-levered using the relevant company's average gearing ratio over the period and re-levered using the 60 per cent assumption. The details of this de-levering/re-levering process can be found in Appendix 20.

893. The estimates of equity beta for each company in the sample are presented in the following manner for comparison:

- *First*, estimated equity betas for those companies that are included in the sample of both the Authority's 2011 and 2013 studies. Only the OLS and the LAD methods are considered for consistency with the estimates obtained from the Authority's 2011 study (see Table 18).
- *Second*, estimated equity betas, using the updated data set to April 2013, using all four methods, namely the OLS; the LAD; the MM; and the Theil-Sen methods (see Table 19).

[365] Australian Energy Regulator (2008), "Explanatory Statement: Electricity transmission and distribution network service providers Review of the weighted average cost of capital (WACC) parameters, www.aer.gov.au, p. 200.

Table 18 Estimated Equity Betas in the Authority studies in 2011 and 2013 using OLS and LAD

Company	APA	DUE	ENV	HDF	SKI	SPN
			The Authority's study in 2011			
OLS	0.6041	0.2971	0.3681	1.1873	0.5178	0.2677
LAD	0.5990	0.2438	0.3465	0.8907	0.3889	0.2452
N	540	400	540	383	330	330
			The Authority's study in 2013			
OLS	0.6138	0.2255	0.3714	1.2025	0.5427	0.1248
LAD	0.5556	0.2391	0.3548	0.9725	0.4390	0.2601
N	589	453	589	415	383	383

Source: The Economic Regulation Authority's estimates

894. The results show that the estimates of the equity beta have remained relatively stable over time.

Table 19 Estimates of equity beta for individual firms in 2013 using all four methods

	APA	DUE	ENV	HDF	SKI	SPN	Average
Gearing	0.5418	0.742	0.6884	0.3936	0.4436	0.6107	**0.5700**
OLS	0.5930	0.1746	0.4425	1.1970	0.5432	0.0490	**0.4999**
LAD	0.5549	0.2331	0.4434	1.1054	0.3668	0.2563	**0.4933**
Robust MM	0.6334	0.2507	0.4497	1.0015	0.4801	0.3043	**0.5199**
Thiel Sen	0.5643	0.2656	0.4456	1.0054	0.3915	0.2221	**0.4824**
Average	**0.5864**	**0.2310**	**0.4453**	**1.0773**	**0.4454**	**0.2079**	**0.4989**

Source: The Economic Regulation Authority's estimates

895. Table 19 shows that, on average, the MM robust regression produces higher estimates of equity beta than the OLS method. The Theil-Sen method produces the lowest estimates of equity beta. On average, both OLS and LAD methods produce the estimates of equity beta which fall between the two newly proposed methods: the MM and Theil-Sen methods. It is noted, however, that for individual companies, the two newly adopted methods in this 2013 study can produce estimates of equity beta that can be higher or lower than estimates derived using the two methods adopted in the Authority's study in 2011.[366]

896. As such, the Authority is of the view that there is no biased tendency to over- or under-estimate equity beta when the two new methods are adopted. In comparison with the estimate equity betas from the OLS method, equity betas estimated from the LAD, MM and Theil-Sen methods appear to be more consistent. As a consequence, the Authority considers that estimates of equity

366 The high resulting estimate for HDF is a result of their low average gearing resulting in a large levering factor to represent 60 per cent gearing which is then applied to the raw beta estimate.

beta using the OLS method may have been strongly influenced by the outliers from the sample.

12.3.4.5 Portfolio analysis

897. The key purpose of a portfolio analysis is to allow a single portfolio to be created and, as such, a single corresponding equity beta for that portfolio can be estimated as an equity beta of the industry. It is noted that companies may enter and leave the industry at various points of time. As a result, portfolios are required to be recreated when there is a new composition of the industry (i.e. where there is a firm which leaves the industry and/or a firm that enters into the industry).

898. In 2009, Henry's study contained six portfolios. The Authority's 2013 study contains only five portfolios because Bloomberg data for both SPN and SKI became available in the same week. As such, the sixth portfolio, which reflected the later 'drop in' date for SKI as in Henry's study, is not needed. Two scenarios are considered in this study which is consistent with the approach adopted in Henry's 2009 study: (i) equally-weighted portfolios; and (ii) value-weighted portfolios. As a result, the total of ten portfolios is created in this 2013 study. Of these 10 portfolios, five portfolios are equally-weighted, and the other five portfolios are value-weighted. The constructions of equally-weighted and value-weighted portfolios are illustrated in Appendix 21.

899. The structure of the portfolios and their starting dates are listed in Table 20 below.[367]

Table 20 Portfolios in the Authority's 2013 study

Portfolio	Start Date	Firms in Portfolio					
P0	4/01/2002	ENV	APA				
P1	5/09/2003	ENV	APA				
P2	20/08/2004	ENV	APA	DUE			
P3	17/12/2004	ENV	APA	DUE	HDF		
P4	23/12/2005	ENV	APA	DUE	HDF[368]	SPN	SKI

Estimated beta for the equally-weighted portfolios

900. The five equally-weighted portfolios consisting of n companies have all observations of returns weighted by $1/n$ to form a single set of portfolio return observations for each equally-weighted portfolio. Further details of this construction can be found in Appendix 21.

[367] It is noted that time-varying portfolios, where non-constant portfolio weights are used, were not constructed due to the substantial measurement error that results from this approach. This concern has been raised in Henry's 2009 study.

[368] It is noted that data for HDF only covers the period from 23 December 2005 to 23 November 2012. All other companies in the portfolio have data available until 19 April 2013.

Table 21 Equally- Weighted Portfolio Beta Estimates

	P0	P1	P2	P3	P4	Average
Gearing	0.6187	0.6310	0.6752	0.6046	0.5854	**0.6230**
OLS Beta	0.4892	0.4938	0.3870	0.5497	0.4915	**0.4823**
LAD Beta	0.5335	0.5431	0.4123	0.5804	0.5903	**0.5319**
MM Beta	0.4863	0.4980	0.4104	0.5794	0.5644	**0.5077**
Theil-Sen Beta	0.4351	0.4592	0.3976	0.5461	0.5254	**0.4727**
Average	**0.4860**	**0.4985**	**0.4018**	**0.5639**	**0.5429**	**0.4986**
Observations	589	503	453	415	362	

Source: The Economic Regulation Authority's estimates

901. Table 21 on average, the LAD and MM methods produced higher beta estimates across the portfolios than did the OLS and Theil-Sen methods. This is broadly consistent with the estimated equity betas for individual firms as presented in Table 19 above. Portfolio 3 starting in December 2004 produces the highest estimate on average across all four methods while Portfolio 2 produces the lowest estimates. The most up to date portfolio (Portfolio 4) produces the second highest estimate of around 0.54.

Estimated beta for the value-weighted portfolios

902. The average market capitalisation was calculated for each firm, which remained listed until 2013, over the period from when they first appeared. For each firm in the portfolio, its weight is determined by the ratio between the average of a single firm and the sum of the averages of all firms in each portfolio in terms of market capitalisation. The averages were taken over a sample period for all firms in each portfolio. The weights were then applied to their relevant firms in the portfolio. Further details of this construction can be found in Appendix 21**.**

Table 22 Value- Weighted Portfolio Beta Estimates

	P0	P1	P2	P3	P4	Average
Gearing	0.5929	0.6093	0.6638	0.6319	0.6002	**0.6196**
OLS Beta	0.5277	0.5274	0.3987	0.4733	0.3989	**0.4652**
LAD Beta	0.5555	0.5515	0.4362	0.5119	0.5072	**0.5125**
MM Beta	0.5279	0.5321	0.4321	0.5100	0.4936	**0.4991**
Theil-Sen Beta	0.4729	0.4880	0.4143	0.4944	0.4541	**0.4648**
Average	**0.5210**	**0.5248**	**0.4203**	**0.4974**	**0.4635**	**0.4854**
Observations	589	503	453	415	362	

Source: The Economic Regulation Authority's estimates

903. For the value-weighted portfolios, on average, the beta estimates from the LAD and MM methods are higher than those estimated from the OLS and the Theil-Sen methods. As presented in Table 22, *Portfolio 1* produces the highest estimates while *Portfolio 2* produces the lowest beta estimates. The latest portfolio (*Portfolio 4*) produces an average estimate of approximately 0.46 which is lower than the average estimate under the equally-weighted portfolio approach. However, the average of estimated equity beta across all portfolios under the value-weighted approach is 0.4854, which is lower than the average of 0.4986 under the equally-weighted portfolio approach.

12.3.4.6 Tests of statistical significance of the estimates of betas

904. It is argued that estimates of equity beta using historical data lack robustness and the estimates approaches do not take into account a significant issue known as thin trading. As such, the Authority has conducted its tests of robustness in response to these two concerns.

905. The following section presents tests of statistical significance for various scenarios: (i) estimated beta for individual firms; (ii) estimated beta for the equally-weighted portfolios; and (ii) estimated beta for the value-weighted portfolios. Each of these three scenarios is discussed in turn below.

Statistical significance of estimated beta for individual firms

906. Table 23 presents the t-statistics of beta estimates for individual firms. It is noted that the t-statistics over 1.96 indicate that the beta estimate is statistically different from zero at the 5 per cent level of significance. The Authority notes that the values for Duet (**DUE**) and SP Austnet (**SPN**) are the only two values that are not statistically significantly different from zero under the OLS method. However, the Authority notes that, for other methods including the LAD, Robust MM and Thiel-Sen estimates, all beta estimates are all statistically significant at the 5 per cent level of significance.

907. The Theil-Sen estimates are all significant at the 5 per cent level. Although a standard error cannot be calculated using this method, the fact that the lower band of the 95 per cent confidence interval does not contain zero indicates that the estimates are significant at the 5 per cent level of significance.

Table 23 Statistical significance of estimates of betas for individual firms

	APA	DUE	ENV	HDF	SKI	SPN
OLS						
t-statistic	7.0746	1.8116	6.0787	3.8758	2.9859	0.3038
Beta Upper bound	0.7572	0.3635	0.5851	1.8023	0.8998	0.3648
Beta Lower bound	0.4287	-0.0143	0.2998	0.5917	0.1866	-0.2669
LAD						
t-statistic	8.4091	5.5719	22.1069	19.5201	4.6622	3.7430
Beta Upper bound	0.6842	0.3151	0.4827	1.2164	0.5210	0.3905
Beta Lower bound	0.4256	0.1511	0.4041	0.9944	0.2126	0.1221
Robust MM						
t-statistic	8.9345	6.1857	8.2328	8.3040	5.0602	4.3751
Beta Upper bound	0.7723	0.3301	0.5567	1.2379	0.6661	0.4407
Beta Lower bound	0.4944	0.1712	0.3426	0.7651	0.2942	0.1680
Theil-Sen						
Upper Bound	0.7193	0.3727	0.5758	1.2942	0.6341	0.3920
Lower Bound	0.3988	0.1640	0.3174	0.7174	0.1559	0.0477
N	261	261	261	240	261	261
R-Square (OLS)	0.1619	0.0125	0.1249	0.0594	0.0333	0.0004

Source: The Economic Regulation Authority's estimates

908. In his study in 2009, Henry noted that a concern from the Strategic Finance Group was that there is evidence of bias in regressions with the R^2 values which are less than ten percent in the samples of 48 observations.[369] However, the Authority is of the view that, given the Authority's preference is to use weekly data, the number of observations in the sample is far greater than 48 observations, as presented in Table 23 above, this concern is not an issue in this study.

Statistical significance of estimated beta for the equally-weighted portfolios

909. Tests of statistical significance of estimated beta for all four methods adopted in the equally-weighted portfolios are conducted. The outcomes from the tests are presented in Table 24 below.

[369] Henry, O. 2009, "Estimation Beta", *Advice Submitted to the Australian Competition and Consumer Commission*, 48.

Table 24 Statistical Significance of the Equally-Weighted Portfolio Equity Beta Estimates

	P0	P1	P2	P3	P4
The OLS method:					
Standard Error	0.0427	0.0434	0.0425	0.0594	0.0617
t-statistic	11.47	11.37	9.10	9.26	7.97
Upper Bound	0.5728	0.5790	0.4703	0.6662	0.6124
Lower Bound	0.4056	0.4087	0.3036	0.4333	0.3707
The LAD method:					
Standard Error	0.0323	0.0338	0.0364	0.0413	0.0437
t-statistic	16.51	16.06	11.33	14.07	13.51
Upper Bound	0.5968	0.6094	0.4836	0.6613	0.6759
Lower Bound	0.4702	0.4769	0.3410	0.4996	0.5047
The MM method:					
Standard Error	0.0334	0.0335	0.0287	0.0357	0.0395
t-statistic	14.56	14.88	14.30	16.25	14.30
Upper Bound	0.5517	0.5636	0.4666	0.6493	0.6417
Lower Bound	0.4208	0.4324	0.3541	0.5095	0.4870
The Theil-Sen method:					
Upper Bound	0.5168	0.5389	0.4676	0.6362	0.6219
Lower Bound	0.3511	0.3739	0.3267	0.4591	0.4219

Source: The Economic Regulation Authority's estimates

910. The equally-weighted portfolio OLS beta estimates were all statistically significant at the 5 per cent level of significance. The most current and diversified portfolio (*Portfolio 4*) has the highest standard error, while the least diversified portfolio (*Portfolio 0*) has the lowest standard error. The Authority considerers that this difference most likely reflects the much larger sample size in *Portfolio 4* over which the variance can be scaled down.

911. It is noted that the LAD equally-weighted estimates draw inference from the strong assumption that they are t-distributed. All estimates are statistically significant at the 5 per cent level. The standard errors under this method are lower than those of the OLS estimates and tend to increase with the increase in sample size.

912. The equally-weighted portfolio MM robust estimates also draw inference from the strong assumption that they are t-distributed. All estimates are statistically significant at the 5 per cent level. The standard errors in this method are lower than those estimated from the OLS method and generally lower than those of the LAD estimates as well. The Authority notes that the standard errors in this method appear to be less sensitive to the reduction in sample size than in the estimates from the OLS and LAD methods.

913. The Authority notes that, given that none of the lower confidence intervals contain zero, the Theil-Sen estimates are all statistically significant at the 5 percent level.

Statistical significance of estimated beta for the value-weighted portfolios

914. Tests of statistical significance of estimated beta for all four methods adopted in the value-weighted portfolios are now conducted. The outcomes from the tests are presented in Table 25 below.

Table 25 Statistical Significance of the Value-Weighted Portfolio Equity Beta Estimates

	P0	P1	P2	P3	P4
The OLS method:					
Standard Error	0.0469	0.0476	0.0453	0.0513	0.0605
t-statistic	11.25	11.07	8.80	9.23	6.60
Upper Bound	0.6197	0.6208	0.4875	0.5738	0.5175
Lower Bound	0.4357	0.4341	0.3100	0.3728	0.2804
The LAD method:					
Standard Error	0.0421	0.0429	0.0330	0.0337	0.0342
t-statistic	13.21	12.84	13.21	15.20	14.85
Upper Bound	0.6379	0.6357	0.5010	0.5779	0.5742
Lower Bound	0.4731	0.4674	0.3715	0.4459	0.4403
The MM method:					
Standard Error	0.0365	0.0360	0.0302	0.0332	0.0396
t-statistic	14.45	14.80	14.33	15.35	12.48
Upper Bound	0.5995	0.6026	0.4912	0.5751	0.5712
Lower Bound	0.4563	0.4616	0.3730	0.4449	0.4161
The Theil-Sen method:					
Upper Bound	0.5518	0.5706	0.4841	0.5923	0.5996
Lower Bound	0.3749	0.3959	0.3382	0.4274	0.4068

Source: The Economic Regulation Authority's estimates

915. All estimates using all four different methods are statistically significant at a 5 per cent level of significance. In addition, the Theil-Sen estimates are all statistically significant at 5 per cent given that none of the lower confidence intervals contain the value of zero.

12.3.4.7 Thin trading

916. Another concern in relation to regression analysis to estimating equity beta is that some securities do not trade regularly. As such, this may bias the OLS beta estimates toward zero. In his study, Henry had tested the evidence of thin trading by using Dimson's betas and test statistics. The Authority had adopted this test in its 2011 study. This test is now adopted in this new study in 2013.

917. The following regression is used in order to get the estimates of lagged, coincident and leading betas.[370]

$$r_{i,t} = \alpha_i + \beta_{i-1} r_{m,t-1} + \beta_{i-1} r_{m,t} + \beta_{i-1} r_{m,t+1} + \varepsilon_{i,t} \qquad (22)$$

[370] Other variations of this regression omit the leading term, such as Morningstar's 'sum beta'. This specification, however, is more robust as it accounts for lags that run both from the market to the individual stock and from the individual stock to the market.

918. The all three estimated betas are then summed to produce a Dimson's beta estimate.[371]

$$\hat{\beta}_i^D = \hat{\beta}_{i-1} + \hat{\beta}_i + \hat{\beta}_{i+1} \tag{23}$$

919. The null hypothesis $\beta_i^{OLS} = \beta_i^D$ is tested using the test statistics outlined in equation (6) below. The rejection of the null hypothesis is to present an evidence of thin trading.

$$t = \frac{\hat{\beta}_i - \hat{\beta}_i^D}{SE(\hat{\beta}_i)} \tag{24}$$

920. At a five per cent level of significance, absolute values for the t-test with values greater than 1.96 indicates evidence of thin trading.

921. The findings from this test are presented in Table 26 below. The Authority is of the view that there is no evidence of thin trading in the sample. This conclusion is similar with Henry's view in his 2009 study.

Table 26 Dimson's thin trading tests

	ENV	APA	DUE	HDF	SKI	SPN
Lagged Beta	0.0990	-0.0467	0.2365	0.1631	0.0974	0.1305
Standard Error	0.1000	0.0801	0.1501	0.2104	0.1332	0.1659
Beta	0.5680	0.5176	0.2707	0.7896	0.3905	0.0503
Standard Error	0.0934	0.0732	0.1494	0.2037	0.1308	0.1656
Lead Beta	0.0073	-0.1047	-0.1593	-0.1645	-0.1597	-0.0996
Standard Error	0.1002	0.0799	0.1506	0.2100	0.1331	0.1661
Dimson's Beta	**0.6744**	**0.3662**	**0.3479**	**0.7882**	**0.3281**	**0.0813**
t-test	**-1.1381**	**2.0697**	**-0.5168**	**0.0068**	**0.4769**	**-0.1869**

Source: The Economic Regulation Authority's estimates

12.3.5 Evaluation

922. The Authority is of the view that the models that have been adopted by the AER and the Authority in the past are appropriate for the purpose of the rate of return guidelines. The Authority's study in 2013 is grounded on Henry's study in 2009 which was adopted by the AER in its 2009 WACC Review. The approach taken by Henry in his 2009 study is well established in literature in relation to an estimate of equity beta.

923. The Authority's study in 2013 covers a more up to date data set and employs some other econometric methods to ensure that estimates of equity beta are more robust than those of previous studies. The Authority considers that the approach taken in its 2013 study is appropriate for the rate of return guidelines. The approach is transparent and the findings derived from the approach can be replicated by interested parties.

[371] Dimson, E. And P. Marsh (1983) "The stability of UK risk measures and the problem in thin trading", *Journal of Finance*, 38 (3) pp. 753 - 784

12.3.5.1 Sampling issues

924. Different samples of companies will produce different estimates of equity beta. For the benchmarking purpose with regulated utilities, Henry had considered the rationales for including 9 businesses in his sample. Most of these companies are operating in gas industry as presented in Table 17 above and 0. In its WACC review in 2009, the AER was of the view that Henry's sample was appropriate.

925. In its 2011 study, the Authority had adopted the same sample of 9 businesses. In its 2013 study, the Authority has again adopted the same sample of 9 companies. However, three of the nine companies do not have the necessary data available until April 2013. As such, they are excluded from the sample.

926. The Authority is not aware of any new business in Australian which can be considered relevant to Australian regulated gas businesses. As such, no new company is included in the sample in this 2013 study.

12.3.5.2 Determining point estimates

927. The Authority is of the view that the use of sufficient data and the application of various econometric techniques are the best means to ensure estimates are as robust as possible.

928. The Authority is aware that weekly sampling is preferred to monthly sampling because of a greater number of observations in the sample. This view is based on Professor Henry's advice to the AER in 2009. In addition, the Authority notes that betas from portfolio estimates are preferred to betas estimated for individual firms. This view is supported by Professor Myers in his submission to the Authority.

929. However, the Authority is of the view that distributions of estimates of equity beta from different individual companies and different portfolios are required to examine the most relevant estimate of equity beta. The Authority's study in 2013 indicates that the majority of estimates of equity beta are clustered around 0.5.

12.3.5.3 Viable alternative methods for the estimate of equity beta for regulated businesses

930. Different econometric methods have different strengths and weaknesses. As such, an application of a range of selected methods to the estimates of equity beta is used so as to produce the most robust estimate possible. In his 2009 study, Henry adopted the OLS and the LAD methods. The Authority also adopted these two methods in its 2011 study.

931. In this 2013 study, together with the previously adopted methods (OLS and LAD), the Authority has also adopted two new methods: the MM and the Theil-Sen methods.

932. As discussed in Appendix 17, the OLS method fails to capture the effects from outliers in the sample. The Authority is aware that there are concerns about the validity of the OLS estimator of β in the presence of outliers. In his study, Henry also outlined the possibility of the existence of heteroscedasticity in the estimate of beta. This means that the residuals may be related to the observation,

$\text{Var}[\varepsilon_{i,t}] = \sigma_i^2$. Henry suggested using the Least Absolute Deviations ***(LAD)*** estimator, to reduce the influence of outliers on the resulting beta estimate.

933. LAD estimators belong to a class of estimators known as robust estimators. Such estimators are not heavily influenced by deviations from the assumptions underlying regression analysis. 0 contains a discussion on the failure of OLS and the use of robust statistical procedures if the traditional assumptions underlying regression analysis fail. Andersen (2008) [372] noted that unless the data is very well behaved, different robust estimators may give very different estimates. Andersen suggests that it is prudent to consider the results of multiple robust estimators, in addition to OLS and compare the results when estimating regression coefficients. As a result, the Authority considers it appropriate to utilise additional robust estimators in addition to the LAD estimator in estimating the equity beta for regulated gas distribution networks in the rate of return guidelines.

934. The MM estimator has previously been utilised in studies which have been used in regulatory decisions with respect to gamma.[373] The Authority has also adopted this MM method in its recent empirical study on the estimate of the market value of franking credits. The MM regression is a form of robust regression that has a high breakdown point (50 per cent) and high statistical efficiency (95 per cent). The MM regression has the highest breakdown point and statistical efficiency of robust regression estimators currently available, and for this reason, it is adopted in the Authority's study on equity beta in 2013. Further details on this MM method are provided in Appendix 17.

935. Fabozzi (2013)[374] suggests the use of the Theil-Sen estimator for estimating the appropriate value for the equity beta. Fabozzi proposes this estimator in response to the OLS estimator being acutely sensitive to outliers. Appendix 17 contains a technical discussion on the Theil-Sen estimator. Fabozzi proposes that outliers in financial data are far more common than is usually assumed, and that it is surprising that the Theil-Sen estimator is not more widely used and appreciated. This was one of the main reasons behind the Authority's adoption of the method in its 2013 study.

12.4 Draft Guidelines

936. The Authority is of the view that the methodology set out in its 2013 study on the equity beta, as reported in this Draft Explanatory Statement, has demonstrated the following characteristics. *First*, the study is transparent and the outcomes can be reproduced by interested parties. *Second*, the rationales for selecting a sample and data period are transparent and supported by previous studies. *Third*, the 2013 study has employed various econometric techniques to ensure that estimates of equity beta are robust.

[372] Andersen, R. (2008). *Modern Methods For Robust Regression.* Thousand Oakes: SAGE Publications, pp.91-92.

[373] SFG 2011, *Dividend drop-off estimate of theta*, A report to the Australian Competition Tribunal and the Australian Energy Regulator, Final Report, 21 March 2011

[374] Fabozzi, F.J(2013) Encyclopaedia of Financial Models, Wiley Publications, p442.

937. As a result, the Authority considers that its 2013 study, as reported in this Draft Explanatory Statement, satisfies its criteria for choice of method for the equity beta.

13 Debt and equity raising costs

938. Debt and equity raising costs are the administrative costs incurred by businesses in the process of raising or refinancing debt or equity.

939. This chapter sets out the Authority's considerations with regard to these costs.

13.1 Debt raising costs

940. Debt raising costs may include underwriting fees, legal fees, company credit rating fees and any other costs incurred in raising debt finance. A company has to pay debt raising costs over and above the debt risk premium. Such debt raising costs are likely to vary between each issuance of debt depending on the borrower, lender or market conditions.

13.1.1 Current approaches

941. Regulators across Australia have typically included an allowance to account for debt raising costs in their regulatory decisions. This allowance is treated differently by different regulators. For example, the ACCC (post 2002) and then, the Australian Energy Regulator (**AER**), have considered this allowance as a cost item in the operating expenses whereas all other State-based regulators, including the Authority, have incorporated this allowance in the rate of return calculations. More detail on the ACCC and AER's estimates is set out at Appendix 22.

942. Australian regulators use benchmark estimates when determining debt raising costs. In doing this, regulators attempt to derive an estimate of debt raising costs that mimics debt raising costs that would be incurred by a well-managed benchmark business operating in a competitive market.

943. Based on the advice from the Allen Consulting Group (**ACG**) in December 2004 (see Appendix 22 for more detail), the Australian Competition and Consumer Commission (**ACCC**) concluded that debt raising costs were a legitimate expense that should be recovered through the revenues of a regulated utility.[375] This conclusion is consistent with the ACCC's decisions on the issue of debt raising costs in its regulatory decisions prior to 2004.[376] [377]

944. The costs included in the estimates of the debt raising costs, as indicated by the ACG in its 2004 estimate and adopted by the ACCC, are outlined below:

- gross underwriting fee*: this* includes *management fees, selling fees, arrangement fees and the cost of an underwriter for the debt;*
- legal and roadshow fee*: this* includes *fees for legal documentation and fees involved in creating and marketing a prospectus;*

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375 The Australian Competition and Consumer Commission, 2005, Final Decision, *NSW and ACT Transmission Network Revenue Cap, TransGrid 2004/5 to 2008/9*, April 2005, p. 144.

376 The Australian Competition and Consumer Commission, 2002, Final Decision, *South Australian Transmission Network Revenue Cap, 2003 to 2007/8*, December 2002, p. 25.

377 In this decision, the ACCC incorporated an allowance of debt raising costs in the regulated cost of capital.

- company credit rating fee*: a credit* rating *is generally required for the issue of a debt raising instruments, a company is charged annually by the credit rating agency for the services of providing a credit rating;*
- issue credit rating fee*: a separate credit* rating *is obtained for each debt issue;*
- registry fee*: the maintenance of the* bond *register; and*
- paying fee*: payment of a* coupon *and principal to the security holder on behalf of the issuer.*

945. In addition, in its report to the ACCC in December 2004, ACG considered that some transaction costs associated with debt would continue to be incurred for the whole value of the investment.[378] ACG was also of the view that the most appropriate means of recovering these debt raising costs would either be as an addition to the estimated weighted average cost of capital (**WACC**) or as a direct allowance to operating expenses.[379]

946. ACG's 2004 study determined debt raising costs based on long-term bond issues, consistent with the assumptions applied in determining the costs of debt for a benchmark regulated entity. Debt raising costs were based on costs associated with Australian international bond issues and for Australian medium term notes sold jointly in Australia and overseas. Estimates of these costs were equivalent to 8 to 10.4 basis points per annum when expressed as an increment to the debt margin.[380]

947. The Authority and other regulators, except the ACCC and AER, have consistently adopted an estimate of debt raising costs of 12.5 bppa in its previous regulatory decisions (Table 27). This allowance is based on the ACCC's 2004 estimates. As noted above, the ACCC and the AER have incorporated these costs in the operating expense cash flows.

948. It is also noted that the Independent Pricing and Regulatory Tribunal (**IPART**) recently increased this allowance to 20 basis points per year. IPART was of the view that this revised allowance of debt raising costs of 20 basis points better reflected its adopted term to maturity of 5 years.[381]

949. Other evidence has been also provided to the AER by Associate Professor Handley from the University of Melbourne in April 2010 to confirm that cost components in its estimates of the debt raising costs are appropriate.[382]

[378] Allen Consulting Group, December 2004, Debt and equity raising transaction costs: Final report to ACCC.

[379] Allen Consulting Group, 2004, *Debt and equity raising transaction costs: Final report to ACCC*, December 2004, p. xix.

[380] Allen Consulting Group, December 2004, Debt and Equity raising transaction costs: Final report to ACCC.

[381] Independent Pricing and Regulatory Tribunal, 2011, *Final Decision – Developing the approach to estimating the debt margin*, April 2011, p. 3

[382] Handley, J., April 2010, *A Note on the Completion Method*, Report prepared for the Australian Energy Regulator

Table 27 Debt raising costs in the Australian regulatory practices

Regulator	Year	Allowance (bppa)
ACCC[383]	2011	8.02 - 8.9
AER[384]	2012	Circa of 10 but treated as an operating expense
ERA[385 386]	2012	12.5
IPART[387]	2012	20
QCA[388]	2012	12.5
ESCOSA[389]	2012	0

Source: Compiled by the Economic Regulation Authority

13.1.2 Summary of submissions

950. In the Authority's Consultation Paper, *Guidelines for the Rate of Return for Gas Transmission and Distribution Networks,* published on 21 December 2012, the Authority sought submissions from stakeholders on the estimates and methodology of estimation of debt raising costs.

951. None of the 11 submissions received by the Authority included commentary on the estimation of debt raising costs. However, a number of issues surrounding the estimation of debt raising costs have been raised previously by regulated businesses. Specifically, submissions to the Authority, the AER, and other Australian regulators have contained a range of issues that relate to debt raising costs. The Authority has identified six issues that it considers warrant further discussion. Each of these issues is outlined below.

952. *First*, in its 2012 application to the Australian Competition Tribunal, DBNGP (WA) Transmission Pty Ltd claimed that the ACG report on *Debt and Equity Raising Transaction Costs* had become obsolete because this report was prepared in 2004.[390]

953. *Second*, Competition Economist Group (**CEG**) argued in its paper, *Nominal Risk Free Rate, Debt Risk Premium and Debt and Equity Raising Costs* (prepared for TransGrid in 2008) that the use of international private placement markets to

383 Australian Competition and Consumer Commission, Inquiry to make final access determinations for declared fixed line services — Final report, July 2011, p. 71.

384 Australian Energy Regulator, Access Arrangement Information for the ACT, Queanbeyan and Palerang gas distribution network, 1 July 2010 – 30 June 2015 p. 80.

385 Economic Regulation Authority (Western Australia), Final decision on proposed revisions to the access arrangement for Western Power, 2012, p. 21.

386 Economic Regulation Authority, Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline, 31 October 2011, p. 158

387 Independent Pricing and Regulatory Tribunal, Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016, p. 206.

388 Queensland Competition Authority, Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012, p. 498.

389 "The Commission has not added an additional margin to the debt risk premium to reflect the transaction costs that SA Water will incur when raising debt." Essential services commission of South Australia, *Advice on a Regulatory Rate of Return for SA Water- Final Advice, February 2012,* p. 22.

390 The Australian Competition Tribunal, 2012, *Application by DBNGP (WA) Transmission Pty Ltd (no 3) [2012] ACompT 14 to the Australian Competition Tribunal,* p. 69.

estimate underwriting fees was not appropriate because the approach cannot adequately identify the costs of underwriting in Australia.[391] CEG was of the view that using the private placement market as a proxy for Australian underwriting fees results in an underestimate of the actual cost of underwriting.

954. *Third*, CEG argued in its 2008 submission, *Nominal Risk Free Rate, Debt Risk Premium and Debt and Equity Raising Costs*, to the AER (prepared for TransGrid) that indirect costs should be included in estimation of debt raising costs. An example of an indirect cost is the underpricing of debt at the time of issuance.[392] CEG argued that such a cost is a cost to the issuer because the revenue from issuance in the presence of underpricing is lower than if there was no underpricing. CEG submitted to the AER that currently there is no allowance for indirect costs in the estimate of debt raising costs.

955. *Fourth*, in a submission to 'Rule Change Proposals (ERC0134/ERC0135)',[393] ETSA Utilities, CitiPower and Powercor Australia stated that debt raising costs should be clearly categorised in financial statements. They argued that currently, the Rate of Return for Gas Transmission and Distribution Network Guidelines do not provide any formal guidance as to how the non-interest 'other debt costs' should be categorised by the utility. Different types of 'other debt costs' are currently treated differently by the regulators.[394] This results in inconsistencies between the utilities. These regulated businesses consider that 'other debt costs' are "already reported as financing costs and not [operating expenses] in the financial statements of a Network Service Provider."[395]

13.1.3 Considerations of the Authority

956. Each of the above issues previously raised by regulated businesses and their consultants is responded to in turn below.

13.1.3.1 ACG's 2004 report

957. In evaluating the argument that the 2004 ACG's study is obsolete, the Authority viewed recent literature on the debt raising costs of utilities. The Authority established that current estimates of debt raising costs are consistent with the ACG estimates, or lower, for example:

- PricewaterhouseCoopers was appointed by Powerlink to estimate the debt and equity raising costs of Powerlink's debt program for 2013-2017. PricewaterhouseCoopers employed the same methodology as did ACG in 2004 (Appendix 22). PricewaterhouseCoopers found that a debt raising

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391 Allen Consulting Group found that there was a lack of underwriting data in Australia. This prohibits the accurate estimation of underwriting fees. As such, in its 2004 report, the ACG found that international private placement markets were a viable proxy to estimate underwriting fees.

392 Underpricing costs are those which represent the discount, to the fair market price, at which the new securities are issued to investors. Professor Handley, 2009, *A note on the Costs of Raising Debt and Equity Capital* , p. 3.

393 ETSA Utilities, CitiPower and Powercor Australia, 2011, *Joint Response to AER and EURCC Rule Change Proposals (ERC0134/ERC0135)*, p. 154.

394 For example, costs associated with raising debt have been included in the opex block, whilst hedging costs are considered to be implicitly included in the WACC (via the cost of debt).

395 ETSA Utilities, CitiPower and Powercor Australia, 2011 *Joint Response to AER and EURCC Rule Change Proposals (ERC0134/ERC0135),* p. 154.

cost of 9.1 basis points per annum was appropriate for Powerlink debt program of $4,000 million.[396]

- The AER sought advice from Associate Professor Handley on debt raising costs, to inform its final decisions for Network Services Providers. Associate Professor Handley examined submissions from the Network Service Providers, previous decisions made by regulators and literature on the estimation debt raising costs. Associate Professor Handley found that a reasonable estimate of the debt raising costs was between 8 and 12 bppa.[397]

958. Furthermore, the Tribunal, ruling on the DBNGP decision in 2012, did not find that the ACG report was obsolete. The Tribunal did note that the report did not lend itself to comparative analysis; however, this was not sufficient to make it obsolete.

959. Based on these findings, the Authority does not consider that the ACG report is no longer relevant for an estimate of the debt raising costs for regulatory purposes. The Authority is of the view that the approach is robust and this approach has been adopted by the Australian regulators over the last 10 years. In addition, the Authority considers that the approach is still fit for purpose for these rate of return guidelines with input data to be updated as soon as it becomes available.

13.1.3.2 Estimation of Underwriting Fees

960. The Authority considers that it is appropriate to use overseas private placement markets as a proxy for underwriting fees in Australia.[398] The Authority agrees with ACG's findings that:

> *Given the extent of international competition in the bond markets and the fact that these markets should equilibrate over time, ACG believes that this benchmark... [of 5.7 basis points for underwriting fees] is a reasonable proxy for Australian bond underwriting fees.*[399]

961. In its Final Decision on Victorian Electricity Distribution Network Service Providers, Distribution Determination 2011-2015, the AER also determined that fees charged by overseas banks to Australian companies issuing bonds in international markets could be used as an objective and robust source of data to estimate domestic underwriting fees.

962. Furthermore, there is insufficient data available detailing underwriting fees for bond issues in the Australian market to allow for an accurate benchmark to be produced using Australian data.[400] As such, the Authority considers that the use of international private placement markets data is the best proxy for underwriting fees, until sufficient data is available in Australia.

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396 PricewaterhouseCoopers, 2011, *Appendix K Debt and Equity Raising Costs,* Report for Powerlink Queensland, p. 20

397 Associate Professor Handley, 2009, *A note on the Costs of Raising Debt and Equity Capital,* p. 30.

398 This is consistent with the AER's findings.

399 Allen Consulting Group, 2004, *Debt and Equity Raising Transaction Costs,* p. 53.

400 This view is supported by PricewaterhouseCoopers, 2011 *Powerlink Debt and Equity Raising Costs,* p. 15.

13.1.3.3 Indirect Costs

963. The Authority notes that the AER considered the inclusion of underpricing and other indirect costs would be inconsistent with the assumptions of a BBB+ credit rated company.[401] The inconsistency is derived from the view that a company with BBB+ credit rating should not have to underprice its bonds in order to sell them in the market.

964. The Authority considers that the validity of including indirect debt raising costs should be evaluated within the estimate of the debt risk premium. This approach is supported by Associate Professor Handley. In his advice, Henry was of the view that:

> *...such an adjustment should then be made to the cost of debt rather than as an allowance for capital raising costs."*[402]

965. As such, the Authority is of the view that indirect costs should not be included in the allowance for debt raising costs.

13.1.3.4 Accounting for Debt Raising Costs

966. The Authority understands the need for the Rate of Return for Gas Transmission and Distribution Network Guidelines to explicitly state how 'other debt costs' should be treated, and what these costs should specifically include.[403]

967. In addition, as previously indicated, the Authority considers that debt raising costs should include, underwriting fees, legal and road show fees, company credit rating fee, issue credit rating fee, registry fee, and paying fee.

13.1.3.5 Accounting for Swap Allowance and Annual Updating

968. Given the assessment that firms will hedge the on-the-day rate, a swap allowance of 2.5 basis points will be awarded to firms to compensate for the cost of conducting hedging for the exposure to movements in the risk-free rate.

969. The allowance will be based on the whole amount of debt.

13.1.3.6 The Authority's estimate of debt raising costs in 2013

970. As an illustration, the Authority has conducted its own hypothetical estimate of the debt raising cost for the purpose of this rate of return guidelines. In this estimate, the approach used in the ACG 2004 report is adopted.

971. Table 28 below presents the results from this exercise, which assumes that a regulated business has a regulatory asset value (RAB) of A$3,200 million. Given the assumed gearing of 60 per cent, the amount of debt to be raised or refinanced is A$1,920 million, which requires approximately 8 standard-size issues. More detail on the components of the estimate is provided at Appendix 22.

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[401] Competition Economists Group, 2009, *Debt and equity raising costs: A response to the AER 2008 draft decisions for electricity distribution and transmission*, p. 35.

[402] Associate Professor Handley, 2009, *A note on the Costs of Raising Debt and Equity Capital,* p. 16.

[403] Debt raising costs may include underwriting fees, legal fees, company credit rating fees and any other costs incurred in raising debt finance.

972. In this hypothetical example, depending on the number of issues, debt raising costs range from 11.8 bppa to 13.8 bppa. However, these estimates will vary depending on some key assumptions. It is noted that all costs are amortised over 5 years.

Table 28 The Authority's estimate of debt raising costs (bppa), 2013

Fee	Explanation/Source	1 Issue	2 Issues	4 Issues	6 Issues	10 Issues
Total Amount Raised	Multiples of median MTN issue size ($250m)	$250m	$500m	$1,000m	$1,500m	$2,500m
Gross Underwriting Fees	Bloomberg for Australian international issues, upfront per issue, amortised	8.31	8.31	8.31	8.31	8.31
Legal and Roadshow	$195K upfront per issue, amortised	1.85	1.85	1.85	1.85	1.85
Company Credit Rating	$55K for the entire company, per year	2.20	1.10	0.55	0.37	0.22
Issue credit rating	4.5 bps up-front per issue, amortised	1.07	1.07	1.07	1.07	1.07
Registry fees	$4K upfront per issue, amortised	0.04	0.04	0.04	0.04	0.04
Paying fees	$9K per issue per year	0.36	0.36	0.36	0.36	0.36
Totals	**Basis points p.a.**	**13.8**	**12.7**	**12.2**	**12.0**	**11.8**

Source: ACG; Bloomberg; AER; and the Economic Regulation Authority's analysis

13.1.3.7 Evaluation

973. The Authority is of the view that the approach set out in the ACG's 2004 study is appropriate for the purpose of estimating debt raising costs. This approach has been adopted by the Australian economic regulators in their regulatory decisions over the last 10 years. As such, the Authority considers that any estimate of debt raising costs derived using the same approach is fit for purpose.

974. The Authority is not aware of any new alternatives to the ACG method. Recent estimates of debt raising costs including Deloitte's 2010 estimate; PricewaterhouseCoopers' 2011 estimate; the AER's 2013 estimate; and the Authority's estimate in 2013 have all been based on the same approach adopted in ACG's 2004 estimate. However, the Authority is open to consideration of any new methods proposed by regulated businesses.

Data sources

975. The Authority notes that data sources for estimates of debt raising costs are relatively limited. As such, employing various sources of data in the estimates is appropriate. For example, when estimating gross underwriting fees, one of the key components to be included in the estimate of debt raising cost, the data available from Australian bonds issued overseas is considered appropriate. The Authority is of the view that Australian data is the most desirable. However, in circumstances where Australian data is not available, then relevant data from overseas may form a good proxy for the Australian market.

Margin or operating expense cash flows?

976. The Authority notes that debt raising costs may either be included as a margin in the return on debt, or as an explicit cash flow in operating expenses. The Authority notes that these costs are more in the nature of expenses, as compared to a component of the return on debt.

977. The Authority considers that there are some advantages to moving the cash flow approach, given the explicit recognition that firms stagger their debt issuances. Inspection of Table 28 reveals that a number of the contributing costs are fixed costs per issuance. By estimating the average amount of debt required to be refinanced each year, the Authority would be able to make a more accurate estimate of debt raising costs.

978. On this basis, the Authority considers that it is preferable that debt raising costs be accounted for through cash flows in operating expenses.

13.2 Equity raising costs

979. In order to maintain the benchmark debt to equity ratio following increases in the regulated asset base, the firm may need to issue new equity. The issuance of new equity will have transactions costs, depending on the way in which the equity is raised.

980. This equity raising cost issue was not canvased in the Authority's Issues Paper. No submissions addressed this issue.

13.2.1 Current approaches

981. In its most recent decision on Western Power's access arrangement, the Authority provided an allowance for equity raising costs in the operating expense cash flows as follows:

- retained earnings of 30 per cent of after-tax profits are available at zero cost;
- dividends are paid at the benchmark payout ratio of 70 per cent of after-tax profits, with 25 per cent of dividends treated as being reinvested through Dividend Re-investment Plans, with an equity raising cost allowance of one per cent applied;
- any further required equity is raised at the Seasoned Equity Offering cost of 3 per cent – with these costs added to the asset base and depreciated over the life of the assets

982. This approach is consistent with that adopted to date by the Australian Energy Regulator.

13.2.2 Consideration of the Authority

983. The Authority considers that an allowance for the transactions costs of raising equity is justified where an adjustment is required to maintain the debt to equity ratio.

984. The accepted hierarchy for capital raising is:

- retained earnings (and by corollary dividend reinvestment);
- debt;
- new equity injections.

13.2.2.1 Retained earnings and dividend reinvestment

985. The level of retained earnings relates to the dividend the business is expected to pay – retained earnings are after-tax profits, less dividends.

986. The Authority considers that a payout ratio of 70 per cent of after tax profits is a typical benchmark for the dividend payout ratio, leaving 30 per cent of after tax profits as retained earnings. The 70 per cent rate is the same as the payout ratio F utilised for the calculation of the WACC (see chapter 14 – Gamma).

987. Retained earnings are costless to the firm.

988. Evidence from recent data analysed by the Authority covering six utilities suggests that around 25 per cent of annual dividends, on average, are subject to reinvestment plans (Table 29).

Table 29 Dividend re-investment ratios

Name	Year	Dividends ($m OD)	Reinvested ($m OD)	Re-invest. Ratio	5 Year Av.
Origin Energy	2011	226,000,000	61,000,000	26.99%	
	2010	220,000,000	65,000,000	29.55%	
	2009	218,000,000	19,000,000	8.72%	22.74%
	2008	201,040,000	45,000,000	22.38%	
	2007	158,654,000	41,350,000	26.06%	
AGL Energy	2011	143,000,000	61,900,000	43.29%	
	2010	125,500,000	36,400,000	29.00%	
	2009	119,900,000	58,700,000	48.96%	29.38%
	2008	112,700,000	28,900,000	25.64%	
	2007	-	-	No plan	
SP Ausnet	2011	131,400,000	74,800,000	56.93%	
	2010	157,400,000	46,900,000	29.80%	
	2009	124,000,000	26,600,000	21.45%	21.63%
	2008	-	-	No plan	
	2007	-	-	No plan	
DUET Group	2011	-	-	No plan	
	2010	84,709,000	27,072,206	31.96%	
	2009	82,277,000	18,935,563	23.01%	18.56%
	2008	106,420,000	18,885,523	17.75%	
	2007	92,136,000	18,500,000	20.08%	
Spark Infrastructure Group	2011	-	-	No plan	
	2010	-	-	No plan	
	2009	68,178,378	25,226,000	37%	7.40%
	2008	-	-	No plan	
	2007	-	-	No plan	
Envestra Limited	2011	77,500,000	44,300,000	57.16%	
	2010	73,000,000	42,300,000	57.95%	
	2009	75,800,000	32,100,000	42.35%	51.01%
	2008	81,700,000	34,600,000	42.35%	
	2007	77,800,000	43,000,000	55.27%	
All six companies					**24.5%**

Source: Annual reports

989. The AER has previously adopted a cost for dividend reinvestment of 1 per cent. The Authority notes that the AER, in deciding on its approach, took account of a number of studies, as well as its own investigations, concluding:[404]

> The AER has undertaken its own research of the costs of DRPs among domestic energy network businesses. The AER observed that where reported, costs as a portion of equity raised had a median of 0.75 per cent and a mean of 1 per cent. On the basis of all the information considered including the ACG report [zero costs] and Carlton's anecdotal evidence [1.25 per cent], the AER considers that a conservative estimate of 1 per cent is appropriate. The AER considers that this figure is the appropriate unit cost to be applied to the amount of equity assumed to be raised through a DRP.

990. On this basis, the Authority accepts 1 per cent as a reasonable cost for dividend reinvestment.

13.2.2.2 New equity raising costs

991. The quoted cost of 'seasoned equity offerings' (**SEO**) tends to be around 3 per cent. This derives from work in 2004 by the Allen Consulting Group, which recommended:[405]

> If a rights issue (or other SEO) were found to be required, ACG recommends a benchmark transaction cost of 3%, adding the amount of SEO transaction costs to the capital base (RAV) and depreciating over the life of the assets purchased with funds raised by the notional, benchmarked SEO.

992. Shareholders, if they accepted that a major investment was warranted, could accept a lower dividend, for a period, as a means to inject equity – given that this has the lowest financing cost. This could be rational.

993. However, the Authority accepts that many investors seek dividend stability, and that firms seek to service this requirement. Further, decisions by investors to invest additional funds in the business necessarily would be made within the context of their overall portfolios – some investors might view a dividend reduction as inconsistent with their risk preferences. Finally, any reduction in dividends would potentially waste franking credits, which are important for some investors.

994. The Authority considers therefore that given the evidence for dividend reinvestment comprising 25 per cent of dividends (see above), and given that many investors would prefer to make an explicit decision on whether to re-invest dividends in a business, that any additional capital raising requirement that is over and above standard re-investment rates has the nature of SEO, and hence should be charged at the higher SEO cost of raising equity.

995. Finally, Allen Consulting Group imply that some leeway in the debt to equity ratio might also be considered:[406]

[404] Australian Energy Regulator 2009, *Australian Capital Territory Distribution Determination 2009-10 to 2013-14*, www.aer.gov.au, p. 258.

[405] The Allen Consulting Group 2004, *Debt and Equity Raising Transactions Costs*, www.aer.gov.au, p. 69.

[406] The Allen Consulting Group 2004, *Debt and Equity Raising Transactions Costs*, www.aer.gov.au, p. 62 and p. 69.

> There will be a limit to the degree to which a company can increase its gearing to undertake such projects, and at the same time maintain financial viability. Regulators must ensure that the revenue target allowance provides for the regulated utility to maintain its financial viability and a notional investment grade credit rating...
>
> There can be instances of regulated businesses where incremental capital expenditure is very lumpy and a significant equity injection is necessary, as the notional capital structure would be breached for a considerable period (or expected debt covenants associated with the notional capital structure would otherwise be breached). However, ACG is not aware of any specific Australian case in which an SEO raising has been clearly justified for a regulated asset.

996. However, the Authority considers that the benchmark regulatory model assumes a fixed debt to equity ratio in order to reflect the returns that would accrue to a service provider in a commercial enterprise with a similar nature and degree of non-diversifiable risk as the regulated entity. For such an entity, where a large lumpy capital investment is being undertaken that cannot be financed out of retained earnings or standard rates of dividend reinvestment, then new equity raising is justified, with the attendant costs.

13.2.2.3 Tax deductibility of equity raising costs

997. It is assumed that where equity is raised, an additional amount of equity is raised to cover the SEO transactions costs of raising that equity.

998. Certain parts of the equity raising transactions costs may be deductible for tax purposes in the year of the equity raising – including legal fees, accountants' fees and prospectus costs. However, the Authority considers that these costs are small and hence may be ignored for the purposes of the revenue modelling.

13.2.2.4 Accounting for equity raising costs

999. SEO investments will generally be required to maintain the debt to equity ratio when there is significant new investment in assets. In this case, the SEO costs are associated with that new investment.

1000. On this basis, the Authority considers that SEO costs should be added to the regulated asset base, and depreciated over the life of the assets. This was the treatment adopted in the Western Power decision.

13.3 Draft Guidelines

13.3.1 Debt raising costs

1001. Debt raising costs will be treated as financing expenses. As such, debt raising costs should be incorporated in the operating expense cash flows determined in the regulatory decisions.

1002. Debt raising costs should only include the direct cost components recommended by Allen Consulting Group (**ACG**) in their 2004 report to the ACCC and accepted by Australian regulators since then. These costs will be recompensed in proportion to the average annual issuance, and will cover:

- gross underwriting fees: this includes management fees, selling fees, arrangement fees and the cost of an underwriter for the debt;

- legal and roadshow fees: this includes fees for legal documentation and fees involved in creating and marketing a prospectus;
- company credit rating fees: a credit rating is generally required for the issue of a debt raising instruments, a company is charged annually by the credit rating agency for the services of providing a credit rating;
- issue credit rating fees: a separate credit rating is obtained for each debt issue;
- registry fees: the maintenance of the bond register; and
- paying fees: payment of a coupon and principal to the security holder on behalf of the issuer.

1003. Indirect costs are not considered appropriate to be included in the estimate of the debt raising costs.

1004. In addition, a swap allowance of 2.5 basis points will be awarded to firms on the whole of the debt portfolio to compensate for the cost of conducting hedging for the exposure to movements in the risk-free rate.

13.3.2 Equity raising costs

1005. The Authority considers that an allowance for the transactions costs of raising equity is justified where an adjustment is required to maintain the debt to equity ratio.

1006. Equity raising costs will be estimated as follows:

- retained earnings of 30 per cent of after-tax profits will be available to inrease equity at zero cost;
- dividends will be assumed to be paid at the benchmark payout ratio of 70 per cent of after-tax profits, consistent with the estimation of gamma;
- 25 per cent of dividends paid out will be treated as being reinvested through Dividend Re-investment Plans, with an equity raising cost allowance of one per cent applied;
- any further required equity is raised at the Seasoned Equity Offering cost of 3 per cent – with these costs added to the asset base and depreciated over the life of the assets.

1007. SEO costs will be added to the regulated asset base, and depreciated over the life of the assets.

14 Gamma

1008. The Authority is required by the new National Gas Rule (NGR) to set out its approach to estimating the value of gamma, a parameter in the Weighted Average Cost of Capital (WACC). Gamma is a parameter that takes into account the impact the imputation tax system has on the WACC. The imputation tax system removes the possibility of corporate profits being taxed twice. Prior to the introduction of the imputation tax system on 1 July 1987, company profits were taxed once at the corporate level, and taxed again in the form of dividends at the personal level (i.e. as personal income tax). Under the Australian imputation tax system, a franking credit is distributed to individuals with dividends paid so as to offset any personal taxation liability. A full imputation tax system for companies was adopted in Australia on 1 July 1987.

1009. Gamma is the parameter in the WACC that takes into account the value generated by the distribution of franking credits. As a general rule, investors will accept a lower required rate of return on an investment that has franking credits compared with an investment that has similar risk and no franking credits. The precise value investors place on franking credits is ambiguous, given that individual investors have differing circumstances (e.g. differential marginal tax rate). In addition, the distribution of franking credits by companies differs primarily as a result of differences in shares of profit that are liable for taxation and the proportion of profits paid as dividends. As a consequence of these variabilities, the precise value of gamma required under the NGR can be difficult to identify. Appendix 24 outlines how gamma arises from Officers definition of the WACC.

1010. It is widely accepted by Australian regulators that the value of gamma (γ) is a product of two components: these are (i) the fraction of imputation credits created that are assumed to be distributed to shareholders (F); and (ii) the market value of imputation credits distributed as a proportion of their face value (θ). It follows that gamma can be represented by the formula below:[407]

$$\gamma = F \times \theta \qquad (25)$$

1011. The estimate of gamma, and theta (θ) as a component of gamma,, has attracted significant debate in the context of utility regulation. As noted in the Authority's consultation paper, there have been a number of studies conducted which have attempted to estimate the value of theta. The main method used in estimating the value of theta is the dividend drop off methodology. This methodology uses the distribution of franking credits and dividends and assesses the impact that the distribution has on a firm's stock price to infer a market value for franking credits. The Authority noted in its consultation paper that the dividend drop-off technique provides a market based approach for estimating the value of imputation credits, but that it is also recognised that the technique may not be entirely robust.

1012. In its consultation paper, the Authority sought views and supporting information from interested parties on the following:[408]

- What criteria should be used to select an approach/ model for estimating gamma?

[407] Monkhouse, P. (1996) "The Valuation of Projects under a Dividend Imputation Tax System", *Accounting and Finance* 36, pp. 185-212

[408] The Economic Regulation Authority, Consultation Paper: Guidelines for the Rate of Return for Gas Transmission and Distribution Networks, p. 45, December 2012.

- What are the best methods and/or studies for estimating the value of gamma?
- What are the main rationales for estimating gamma via the estimates of the payout ratio and theta? Is it possible to estimate gamma directly from available market data?
- Are there methods – other than for dividend drop off studies – which could estimate the value imputation credits and better meet the new NGR rate of return (RoR) objective and requirements?

1013. The Authority is of the view that the market value of imputation credits should be considered in conjunction with the issues of the return on equity models because gamma is an input parameter. However, the issues of appropriate return on equity models have not been considered yet. As such, this chapter is developed on the assumption that current practice, in which an average investor is considered and that foreign investors are only recognised to the extent they invest in the Australian financial market, is adopted. The interpretation of the findings from empirical studies may be different once the concepts of marginal/average, domestic/foreign investors within the return on equity are sorted out.

14.1 Current Approaches to Estimating Gamma

14.1.1 An estimated value of the payout ratio (F)

1014. Empirical evidence suggests the annual payout ratio of a company in Australia is 0.71.[409] As a consequence, 71 per cent of the return of equity is assumed to be in the form of dividends with corresponding franking credits attached. Therefore, it is assumed that 71 per cent of all imputation credits are distributed to shareholders in the same year they are created.

1015. In 2011, the Australian Competition Tribunal **(the Tribunal**) ruled that the appropriate value for the payout (distribution) ratio, F, was 0.70. The ruling was based on analysis undertaken by Hathaway and Officer in 2004.[410] The Authority is of the view that existing evidence supports the use of a range for the payout ratio of between 70 per cent and 100 per cent. The lower bound of 70 per cent is based on empirical evidence (as referred to above) and the upper bound of 100 per cent is based on the view that imputation credit does have a value. However, in the absence of any new evidence and in the interest of regulatory certainty, the Authority has no basis to depart from the finding of the Tribunal, this being that an appropriate estimate of the payout ratio is 0.70.

14.1.2 An estimated value of theta

1016. The current practice to estimating the value of theta for Australia is to use of the dividend drop off methodology. The Authority has previously adopted a theta of 0.35, together with a payout ratio of 0.70 to produce a gamma of 0.25. These values have been used in the Authority's Draft and Final Decisions on the Proposed Revisions to the Access Arrangement for the Western Power

409 Hathaway, N.J., and Officer, R.R. (2004), *The Value of Imputation Tax Credits,* Working paper, Melbourne Business School.

410 Ibid.

Network.[411] The Authority's adoption of gamma being equal to 0.25 is consistent with the Tribunal's decision on the value of gamma in the case of Energex Limited.[412] However, as noted in its consultation paper, the Authority has indicated that the value of gamma needs to be revisited.

1017. Despite the Tribunal's rulings on the value of gamma of 0.25, other Australian regulators have continued to apply higher gamma values. Table 30 summarises recent Australian regulatory decisions following the Tribunal's ruling.

Table 30 Estimates of Gamma adopted by Australian Regulators

Regulator	Year	Gamma
ACCC[413]	2011	0.45
AER	2012	0.25
ERA[414]	2011	0.25
IPART[415]	2012	0.25
QCA[416]	2012	0.5
ESCOSA[417]	2012	0.5

Source: Compiled by the Economic Regulation Authority

14.2 Estimating Theta: Methods, Models and Datasets

1018. In estimating a value for theta, regulators and academics have relied on three different approaches: (i) the tax statistics, (ii) the dividend drop off; and (iii) the simultaneous price methodology. Each of these three approaches is discussed in turn below.

14.2.1 Tax Statistics Methodology

1019. Tax statistics estimate the utilisation of imputation credits, which is a measure of the imputation credits redeemed by shareholders. In this methodology, the Australian Taxation Office (ATO) statistics are used to observe the proportion of distributed imputation credits that have been used by investors to reduce their personal taxation liabilities. This approach implicitly assumes that the market

[411] Economic Regulation Authority, 2012, Final Decision on Proposed Revisions to the Access Arrangement for the Western Power Network, p. 422.

[412] Australian Competition Tribunal, Application by Energex Limited (Distribution Ratio (Gamma)) (No 5) [2011] ACompT 9 (12 May 2011), paragraph 42.

[413] Australian Competition and Consumer Commission, Inquiry to make final access determinations for declared fixed line services—Final report, July 2011, p. 49.

[414] Economic Regulation Authority (Western Australia), Final decision on proposed revisions to the access arrangement for the Dampier to Bunbury natural gas pipeline, October 2011, p. 141.

[415] Independent Pricing and Regulatory Tribunal, Review of imputation credits (gamma), March 2012, p. 1.

[416] Queensland Competition Authority, Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012, p. 498.

[417] Essential services commission of South Australia, Advice on a regulatory rate of return for SA Water—Final advice, February 2012, p. 49.

value of a redeemed franking credit is equal to its face value, whilst an unredeemed franking credit has no value. It follows that the average market value of a franking credit is equal to the proportion of franking credits redeemed.[418]

1020. Hathaway and Officer (2004) examined national tax statistics in order to estimate the average value of redeemed imputation credits from 1988 to 2002.[419] They calculated that 71 percent of company tax payments had been distributed as imputation credits on average and estimated that 40 to 50 percent of the distributed credits were redeemed by taxable investors. Taking these two factors into account indicated to the authors that the statutory company tax rate is reduced by 28 to 36 percent. This suggested that the effective rate of company taxation is around 19 to 21 percent. They estimated a value of gamma within a range of 0.38 to 0.44. However, they noted that some of their data is not reliable.[420]

1021. Handley and Maheswaran (2008)[421] examined the reduction in individual's tax liabilities due to imputation credits from 1988 to 2004. Their study found that 67 per cent of distributed imputation credits were used to reduce personal taxes between 1990 and 2000, and this increased to 81 per cent over 2001-2004.

1022. The Tribunal has recently addressed the use of tax statistics studies. The Tribunal ruled that aggregate tax statistics should not be used to produce an estimate of theta. Without any explicit explanations, the Tribunal was of the view that tax statistics can only be used to produce an upper bound that can be used as a cross-check of the reasonableness of an estimate produced by some other means. The Tribunal noted that the correct approach to estimating theta is through the use of market data rather than tax statistics.[422]

14.2.2 Dividend Drop-Off Studies

1023. Dividend drop-off (DDO) studies of theta examine how share prices change on ex-dividend days after distribution of both a cash dividend and attached franking credit. The amount by which the share prices change (on average) is assumed to reflect the value investors place on the cash dividend and imputation credit as separate from the value of the shares. Econometrics can then be used to distinguish the component of the price drop off due solely to the value of the franking credits. By performing this analysis over a long period of time and across a large number of dividend events, an average market valuation of franking credits can be obtained.

1024. There are a number of variations of the dividend drop-off studies that have been conducted in Australia, including Walker and Partington (1999), Hathaway and Officer (2004) and Beggs and Skeels (2006). The most recent dividend drop-off study in Australia was conducted by Strategic Finance Group (SFG) in March

[418] NERA Economic Consulting, *The Value of Imputation Credits*, A report for the ENA, Grid Australia and APIA, 11 September 2008, p. 23.

[419] NJ Hathaway & RR Officer, *The Value of Imputation Tax Credits,* working paper, Melbourne Business School, 2004, p. 14.

[420] NJ Hathaway & RR Officer, *The Value of Imputation Tax Credits,* working paper, Melbourne Business School, 2004, p. 14.

[421] Handley, J. And Maheswaran, K. (2008), "A Measure of the Efficacy of the Australian Imputation Tax System", *the Economic Record*, Vol 84, No. 264, pp. 82-94.

[422] Australian Competition Tribunal, *Application by Energex Limited (Distribution Ratio (Gamma))* (No 3) [2010] ACompT 9 (24 December 2010).

2011. The key advantage of DDO studies is that they can be used to provide an estimate of the observed market value of dividends and imputation credits. However, it has been noted that DDO studies have substantial measurement and estimation issues.[423] Appendix 24 contains a detailed discussion on the estimation issues of dividend drop off studies.

1025. These estimation issues associated with dividend drop off studies manifest themselves by the lack of consensus in the literature about the estimate of theta, with its value varying between 0 and 0.57 in recent studies. Table 31 below presents findings from the most recent dividend drop off studies in Australia:

Table 31 Estimated Value of Theta from Various Australian DDO Studies

Author	Year	Data	Techniques	Theta
Brown & Clarke[424]	1993	Statex, Melbourne and Australian Stock Exchange publications, 1973 - 1991	OLS Regression	0.72
Hathaway & Officer[425]	2004	Australian Tax Office and ASX/S&P 500, 1986 - 2004	Generalised Least Squares	0.49
Bellamy & Gray[426]	2004	1995 -2002	Unknown	0.00
Beggs & Skeels[427]	2006	CommSec Share Portfolio 1986 - 2004	Generalised Least Squares	0.57
SFG[428]	2007	Securities Industry Research Centre of Asia-Pacific and FinAnalysis, 1998 - 2006	Generalised Least Squares	0.23
Feuerherdt, Gray & Hall[429]	2010	Securities Industry Research Centre of Asia-Pacific, 1995 - 2002	Generalised Least Squares	0.00
SFG[430]	2011	DatAnalysis, 2000 -2010	Generalised Least Squares	0.35

Source: Compiled by the Economic Regulation Authority

14.2.3 Simultaneous Price Studies

1026. The simultaneous price methodology infers a value for franking credits (and a corresponding value for cash dividends) by observing prices of shares in a company (which entitle the holder to dividends and the associated franking

[423] McKenzie, MD & Partington G, (2010), *Selectivity and Sample Bias in Dividend Drop-Off Studies*, Finance and Corporate Governance Conference 2011 Paper, available at SSRN: http://ssrn.com/abstract=1716576 or http://dx.doi.org/10.2139/ssrn.1716576.

[424] Brown, P. and Clarke, A. (1993), 'The Ex-Dividend Day Behaviour of Australian Share Prices Before and After Dividend Imputation', *Australian Journal of Management,* 1993.

[425] Hathaway, N.J. and Officer R.R. (2004), The Value of Imputation Tax Credits, Working paper, Melbourne Business School.

[426] Gray, S. and Bellamy, D. (2005). Using stock price changes to estimate the value of dividend franking credits. In: P. Gray and E. Margiolis, 2005 Annual Conference Program & Abstracts. AFAANZ 2005 Conference, Melbourne, (108-108). 3-5 July, 2005.

[427] Beggs, D.J. and Skeels, C.L. (2006), 'Market Arbitrage of Cash Dividends and Franking Credits', *The Economic Record*, Vol. 82, No. 258, pp .239–252.

[428] Strategic Finance Group (SFG), *The impact of franking credits on the cost of capital of Australian companies*, Report prepared for ENA, APIA and Grid Australia, October 2007, pp. 35, 45.

[429] Feuerherdt, C., Gray, S. and Hall, J. (2010), 'The Value of Imputation Tax Credits on Australian Hybrid Securities', *International Review of Finance*, 10:3, p. 365.

[430] SFG, Dividend drop-off estimate of theta, Final Report, 21 March 2011.

credits) and derivatives contracts on the same stock (which involve no such entitlement). The difference in the prices of the stock and the implied price of the stock from the derivatives contract provides an estimate of the value of the dividend and the associated imputation credit.

1027. Cannavan, Finn and Gray (2004)[431] inferred the value of franking credits from the relative prices of derivatives contracts on the individual stocks on which they are based. These authors note the problems with the DDO methodology such as considerable heteroscedasticity, multicolinearity, the assumption of a constant value of theta across companies and time as well as microstructure effects. By comparing the prices paid for futures contracts and low exercise price options with the price of the shares, the market value of franking credits is inferred. The study utilised shares from ANZ, BHP, Westpac, Newscorp, National Australia Bank, Western Mining Corporation, MIM Holdings Limited and Rio Tinto and the derivatives written on those shares. They consider the impact of the introduction of the 45 day holding period rule tax on the value of gamma. It was concluded that cash dividends are fully valued by the market. Prior to the introduction of the 45 day holding period rule, franking credits were valued at up to 50 per cent, whilst after the introduction, they were valued at 0.[432]

1028. Simultaneous price studies do not have the estimation issues of dividend drop off studies, such as multicolinearity and heteroscedasticity. However, they suffer from a lack of securities with derivatives contracts written on them. As such, while simultaneous price studies offer an estimate of the market value of franking credits, they are limited by the small sample size of securities available.

14.2.4 Concluding remarks

1029. The Authority considers that dividend drop off studies offer a key advantage in that they calculate an observed market value for franking credits. However, dividend drop off studies are known to suffer from a wide variety of estimation issues that result in the estimated value of theta being vulnerable to the dividend sample, parametric form of the regression equation and regression technique used.[433] [434] Appendix 24 contains a technical summary of the significant issues found with dividend drop off studies.

1030. Tax statistics, whilst not suffering methodology issues, are considered irrelevant for the direct estimation of theta because they fail to take into account the costs investors incur in obtaining franking credits. These costs result in franking credits being valued at less than their face value. In order to qualify for franking credits, investors must take on risk by purchasing and/or holding stocks. In addition, domestic investors forgo the benefits of international diversification and incur transaction costs by qualifying for franking credits. International investors, who cannot utilise franking credits to reduce their personal taxation liability, place no value on franking credits. As a result, tax statistics cannot provide an accurate

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[431] Cannavan, D, Finn F. & Gray,S. 'The value of dividend imputation tax credits in Australia', *Journal of Financial Economics*,73,2004, p.192.

[432] Cannavan, D, Finn F. & Gray,S. 'The value of dividend imputation tax credits in Australia', *Journal of Financial Economics*,73,2004, p.192.

[433] Vo, D., Gellard, B., Mero, S. (2013) 'Estimating the Market Value of Franking Credits, Empirical Evidence from Australia' Conference Paper, *Australian Conference of Economists 2013.*

[434] McKenzie, MD & Partington G, (2010), *Selectivity and Sample Bias in Dividend Drop-Off Studies*, Finance and Corporate Governance Conference 2011 Paper, available at SSRN: http://ssrn.com/abstract=1716576 or http://dx.doi.org/10.2139/ssrn.1716576.

measure of the market value of franking credits. Tax statistics can only provide a theoretical upper bound in a situation where franking credits are costless to obtain.

1031. The simultaneous price methodology has the advantage of providing a market estimate of the value of franking credits, without the methodological issues associated with the dividend drop off technique. However, given the lack of derivatives contracts on stocks, this methodology has data limitation problems.

1032. The Australian Competition Tribunal considered the issue of gamma in its decision on the application of Energex Limited.[435] The Tribunal ruled that the appropriate value for the distribution ration, F, was 0.70 based on the analysis of Hathaway and Officer (2004).[436] On the estimate of theta, the Tribunal relied solely on the use of DDO studies. Of particular note, the ACT had chosen to disregard the use of the Beggs and Skeels (2006) study.[437] The Tribunal concluded that SFG's final 2011 study was the best DDO study available, and as a consequence, the Tribunal used the results of the study in its determination of theta. The Tribunal also noted that the estimate of gamma is an "ongoing intellectual and empirical endeavour".[438] The Tribunal ruled that an appropriate value for gamma is 0.25, given the value of the distribution ratio (F) of .70 and a value of theta (θ) of 0.35.

1033. A recent paper by McKenzie and Partington has concluded the imprecision inherent in the dividend drop off methodology.[439] The authors concluded that the drop-off ratio can vary considerably, depending on the particular specification or regression technique applied. As such, they are of the view that it is appropriate to consider the estimates of theta from various dividend drop-off studies. As a result, the Authority has conducted its own dividend drop off study in order to estimate a value for theta.

14.3 The Authority's Dividend Drop-off study in 2013

1034. Given the lack of consensus on the market value of franking credits (theta), the Authority conducted its own study in 2013. A dividend sample was constructed using well known filters available from the literature and previous studies. Regression techniques and parametric forms of the dividend drop–off equation were also sourced from the literature and other studies. Initial estimates of the value of theta were calculated and then a sensitivity analysis was performed to ascertain the robustness of the estimates. Precise estimates of theta could not be readily obtained due to the high multicolinearity between the net dividend and the franking credit.

[435] Australian Competition Tribunal, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011), paragraph 42.

[436] NJ Hathaway & RR Officer, *The Value of Imputation Tax Credits,* working paper, Melbourne Business School, 2004.

[437] DJ Beggs & CL Skeels, 'Market Arbitrage of Cash Dividends and Franking Credits', *The Economic Record*, vol 82, no 258, 2006, pp. 239–252.

[438] Australian Competition Tribunal, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9 (12 May 2011), paragraph 45.

[439] McKenzie, MD & Partington G, (2010), *Selectivity and Sample Bias in Dividend Drop-Off Studies,* Finance and Corporate Governance Conference 2011 Paper, available at SSRN: http://ssrn.com/abstract=1716576 or http://dx.doi.org/10.2139/ssrn.1716576.

1035. The dividend sample was constructed by observing all securities listed on the Australian Stock Exchange for the period from 1 July 2001 to 1 July 2012 using the Bloomberg terminal. The sample period was selected to begin from 1 July 2001 to avoid structural changes in the company tax rate and imputation credit system in Australia. Only equities listed on the Australian Stock Exchange (ASX) were included. Duplicates were removed to leave a list of 2,595 unique tickers. Of these, anything that was not classed as "common stock" was excluded.

1036. Dividend distribution events for the period were obtained using the Bloomberg spreadsheet calculator "xdvd". Any distribution event that was not classed as regular cash, interim, final or special cash was removed. All dividends that occurred on the same day for a particular stock were aggregated.[440] Dividend events that are classified as special cash only were then removed, as is consistent with other dividend drop off studies.[441] [442] In addition, companies that engaged in stock splits/share buy backs 5 days either side of a dividend event where removed from the sample.[443] [444]This left a list of 8,224 dividend events for 827 unique tickers. The following fields were collected for each dividend event:

- The cum-dividend date closing price.[445]
- The ex-dividend date closing price.[446]
- The gross dividend.[447]
- The net dividend.[448]
- The market capitalisation of the underlying stock on the ex-dividend date.[449]
- The market capitalisation of the all ordinaries index on the ex-dividend date.[450]
- The currency of the dividend event.[451]
- The exchange rate for the dividend currency on the ex-dividend date. [452]
- The return of the All Ordinaries Index on the ex-dividend date.[453]

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440 Special cash dividends are known to be distributed with final or interim dividends.

441 DJ Beggs & CL Skeels, 'Market Arbitrage of Cash Dividends and Franking Credits', *The Economic Record*, vol 82, no 258, 2006, *Appendix II*.

442 Whilst individual special cash dividends are considered unreliable, it is common for companies to distribute a special cash dividend in conjunction with a final or interim dividend. Removing the special cash dividends before the aggregation would imply that the price drop off is due solely to the other dividend, creating an upward bias in the estimate of theta.

443 DJ Beggs & CL Skeels, 'Market Arbitrage of Cash Dividends and Franking Credits', *The Economic Record*, vol 82, no 258, 2006, pp 239–252 Appendix II.

444 This ensures that the price change due to a capitalisation change has no impact on the estimate of theta.

445 Using the *PX_LAST* field in Bloomberg

446 Ibid.

447 Field part of the xdvd spreadsheet

448 Ibid.

449 Using the field in Bloomberg CUR_MKT_CAP

450 Ibid.

451 Field part of the xdvd spreadsheet

452 Using the PX_LAST field for the given currency

453 Calculated by observing the price of the all ordinaries index on the ex-dividend day and the previous trading day using the PX_LAST field in Bloomberg

1037. The sample was further reduced to include only companies that make up at least 0.03 per cent of the All Ordinaries index on the day of the ex-dividend date. This is consistent with other dividend drop off studies and with the approach taken by the Australian Energy Regulator.[454] [455] Any stock found to be paying a dividend denominated in currency other than the Australian dollar was converted to Australian dollars using the closing price exchange rate on the ex-dividend date.[456] Any dividend event that had missing data was removed from the sample. The final sample contains 3,309 dividend events.

1038. To mitigate the issues that exist with dividend drop-off studies, the Authority estimated the value of theta using regression techniques that are robust to deviations from traditional regression assumptions. Given the weaknesses of OLS regression, the Authority derived the estimate of theta using Least Absolute Deviations (**LAD**) and Robust regressions. Estimates of theta using the OLS regressions were calculated for comparison purposes. LAD regression has been used by the Authority in past decisions relating to the estimation of equity beta, as it reduces the influence of outliers on the estimate.[457] In addition, various forms of robust regression have been developed for their ability to handle violations of regression assumptions.[458] MM regression has the highest breakdown point and statistical efficiency of robust regression estimators currently available, as a consequence it was also utilised by the Authority in this study.

1039. Dividend drop off studies are known to contain heteroscedasticity. In order to perform Ordinary Least Squares (**OLS**) analysis, a constant variance term (or homoskedasticity) is required. It is common to adjust the dividend drop-off equation in order to account for this by assuming that the error term of the regression is associated with a variable in the dividend event. The models used by the Authority were sourced from the literature and are shown in Table 32 below:

[454] DJ Beggs & CL Skeels, 'Market Arbitrage of Cash Dividends and Franking Credits', *The Economic Record*, vol 82, no 258, 2006, pp. 239–252 *Appendix II*.

[455] SFG, *Dividend drop-off estimate of theta, Final Report*, 21 March 2011

[456] It is not clear if this was performed in previous DDO studies.

[457] Economic Regulation Authority, Final Decision on Proposed Revisions to the Access Arrangement for the Western Power Network, September 2012, p. 406.

[458] Huber, P.J (1996). *Robust Statistical Procedure,. Second edition,* Philadelphia, SIAM p.1.

Table 32 Models used in Authority's 2013 study

Model	Parametric Form	Scaling Factor	Form of Heteroscedasticity
Model 1	$\frac{P_{c,i}-P_{e,i}}{P_{c,i}}=\gamma_1^{'}\frac{D_i}{P_{c,i}}+\gamma_2^{'}\frac{FC_i}{P_{c,i}}+\varepsilon_i^{'}$	$P_{c,i}$	$\sigma_i^2=k\times P^2{}_{c,i}$
Model 2	$\frac{P_{c,i}-P_{x,i}}{D_i}=\gamma_1^{''}+\gamma_2^{''}\frac{FC_i}{D_i}+\varepsilon_i^{''}$	D_i	$\sigma_i^2=k\times D_i^2$ [459]
Model 3	$\frac{P_{c,i}-P_{x,i}}{D_{ii}s_{e,i}}=\gamma_1^{'''}\frac{1}{s_{e,i}}+\gamma_2^{'''}\frac{FC_i}{D_is_{e,i}}+\varepsilon^{'''}{}_i$	$D_is_{e,i}$	$\sigma_i^2=k\times(D_is_{e,i})^2$
Model 4	$\frac{P_{c,i}-P_{x,i}}{P_{c,i}s_{e,i}}=\gamma_1^{''''}\frac{D_i}{P_{c,i}s_{e,i}}+\gamma_2^{''''}\frac{FC_i}{P_{c,i}s_{e,i}}+\varepsilon^{''''}{}_i$	$P_{c,i}s_{e,i}$	$\sigma_i^2=k\times\left(P_{c,i}s_{e,i}\right)^2$

Where:

$P_{c,i}$ is the cum-dividend price of dividend event i;

$P_{x,i}$ is the ex-dividend day price of dividend event i;

D_i is the cash dividend of dividend event i;

FC_i is the franking credit of dividend event i;

γ_1 is the market value of the cash dividend;

γ_2 is the market value of the franking credit;

σ_i^2 is the variance of the error term of dividend event i, $Var[\varepsilon_i]=\sigma_i^2$; and

$s_{e,i}$ is the historical excess return volatility of stock i.

1040. Table 32 contains the four models that were used by the Authority to estimate theta. SFG also utilised these models in their DDO study.[460] Models 1 and 2 are equivalent to the models utilised by Hathaway and Officer in their 2004 study,[461]

[460] Strategic Finance Group, *Dividend Drop-Off Estimate of Theta, Final Report*, 21 March 2011.

[461] Hathaway, N.J., and Officer, R.R. (2004), *The Value of Imputation Tax Credits,* Working paper, Melbourne Business School.

although they use franking proportion as opposed to the franking credit variable.[462]

1041. The final econometric issue relates to the so-called “market return correction”. Several DDO studies utilise an adjustment for taking into account the market returns on the ex-dividend day price.[463] [464] This approach assumes that each stock has a beta of 1, and returns are fully explained by the Sharp-Linter Capital Asset Pricing Model. Such an assumption is particularly strong especially in the context of this study where the stocks included have a market capitalisation greater than 0.03 per cent of the All Ordinaries Index. It has been argued by McKenzie and Partington (2010) that this adjustment will have no impact on the final value of theta. Beggs and Skeels (2006) noted that this adjustment is imperfect. However, this adjustment is commonly adopted and was notably adopted in the SFG’s paper in 2011. The adjustment was performed in the Authority’s study to enable a comparison of results to those from other studies. The Authority is of the view that applying the market correction is incorrect in determining an appropriate value for theta. Whilst market fluctuations mask investor’s true valuations of franking credits, this is already accounted for by the error term in the regression models.

1042. The value of theta was found to fall within a wide range from 0.11 to 0.73 using standard econometric techniques and 0.35 to 0.55 using more robust techniques. The study showed that the DDO methodology is extremely sensitive to: (i) the underlying construction of the sample, (ii) the parametric specification of the model; and (iii) the regression technique applied. It was observed that the presence of a relatively small percentage of observations can heavily influence the estimate of theta. Whilst the issue of heteroscedasticity and the presence of outliers were controlled for, multicolinearity is still an issue as it is an inherent property of the data. As a result of this study, the Authority considers that any estimate of theta is essentially a function of the most influential observations due to the extreme multicolinearity present in the data. Indeed, this multicolinearity explains the large divergence and lack of consensus in the economic and financial literature. Further details on the Authority’s empirical study on the estimate of theta can be found in Appendix 23 and Appendix 24.

14.4 Summary of Submissions

1043. Submissions were received from DBP and ATCO on the issues presented earlier in this chapter.

14.4.1 DBP

1044. DBNGP (WA) Transmission Pty Ltd (**DBP**) engaged SFG to provide an opinion in relation to the value of gamma that should be used in the context of the regulation of DBP’s regulated pipeline assets.

1045. SFG’s primary conclusions can be summarised as follows.

[462] It can be shown they are equal.

[463] Strategic Finance Group, *Dividend drop-off estimate of theta, Final Report*, 21 March 2011.

[464] Beggs, D. & Skeels, C. ‘Market Arbitrage of Cash Dividends and Franking Credits’, *The Economic Record*, vol 82, no 258, 2006, pp. 239–252.

1046. *First*, SFG considered that gamma is estimated by regulators as the product of two components, F, where F is the distribution rate (the proportion of created imputation credits that are distributed to shareholders) and θ is the value that the relevant shareholder places on a dollar of the distributed credits. The Australian Competition Tribunal has recently held that the best available estimates are: (i) the payout ratio F of 0.70; the theta of 0.35. As a result, the estimated value of gamma of 0.25 is appropriate.

1047. *Second*, SFG noted that the distribution rate, F, can be estimated with reference to observed market data. SFG argued that the payout ratio cannot be set according to a theoretical assumption that is inconsistent with the observed market data. SFG submitted that the Tribunal that the empirical estimate should be used and that the appropriate estimate is 70 per cent.

1048. *Third*, in relation to the estimation of theta, SFG submitted the following points:

- SFG agreed with the Tribunal that redemption rate tax statistics do not provide an estimate of theta and should not be used for that purpose.
- SFG also agreed with the Tribunal that the best available dividend drop-off estimate of theta is 0.35 – from the state-of-the-art SFG study in 2011. This estimate of theta is conditional on cash dividends being valued at 85 cents in the dollar; and
- SFG argued that the best available estimate of theta using the simultaneous security price method is zero from the 2004 study by Cannavan, Finn and Gray. SFG noted that this estimate of theta in the study is conditional on cash dividends being valued at full face value.

1049. *Fourth,* SFG submitted that the dominant market practice is to make no adjustment in relation to imputation credits. However, SFG noted that the current approach by Australian regulators is to make two adjustments. *First*, the estimate of market risk premium (**MRP**) is "grossed-up" to incorporate the assumed effect of imputation credits. Second, the with-imputation estimate of the required return on equity is adjusted downwards to determine the ex-imputation required return on equity. Handley (2010) has advised the Australian Energy Regulator (**AER**) that the first step involves a "gross-up" and then the second step should have "the effect of reversing that gross-up."[3]. SFG considered that a minimum requirement under the Rules is that the regulator is required to:

- implement the market practice approach, specifying its estimate of the MRP unadjusted for imputation credits;
- demonstrate that the two steps of the regulatory approach have the effect of reversing each other in accordance with Handley (2010); and
- as a general WACC estimation principle, for a given parameter, the same value must be adopted consistently throughout a single WACC estimation process. This principle is a requirement under NGR 87(4)(b).

14.4.2 ATCO Gas

1050. ATCO Gas submitted that it was of the view that the dividend drop off study undertaken by SFG in 2011 for the AER to be the best estimate of gamma that is currently available. ATCO notes however that it is possible that in the future, a new estimate of gamma may be estimated.

14.5 Considerations of the Authority

1051. The Authority notes that there are no new issues raised in the SFG's submission on gamma. All these issues had been considered at length in the Authority's previous decisions such as the Final Decision on DBNGP's access arrangement released in 2011. As such, considerations here of the issues which were raised in previous submissions will be brief.

14.5.1 Estimating gamma based on the payout ratio and the theta

1052. The Authority agrees with SFG's submission that gamma should be derived from the two components: (i) the payout ratio; and (ii) the market value of imputation credits (theta). This approach has been consistently adopted by the Authority and other economic regulators in the regulatory decision. The Authority considers that it is appropriate to continue using this approach in the guidelines.

14.5.2 Estimating the payout ratio based on observed market data

1053. The Authority considers that an estimate of the payout ratio of 70 per cent is appropriate based on the empirical evidence currently available. This estimate is consistent with the Tribunal's decision with regard to the value of the payout ratio.[465] In its Final Decisions on DBNGP access arrangement released in 2011, the Authority was of the view that existing evidence, including empirical considerations and theoretical considerations, still supports the use of a range of 70 per cent and 100 per cent for payout ratio. However, for regulatory certainty, the Authority considered that there is no new evidence at this time that would cause the Authority to depart from the findings of the Tribunal in respect of gamma.

14.5.3 Methods to estimating the value of theta

14.5.3.1 Redemption rate tax statistics method

1054. The Authority is aware that the Australian Competition Tribunal has concluded that the market value of franking credits is the appropriate measure for estimating the value of theta. As a consequence, the Tribunal was of the view that tax statistics approach are inappropriate for estimating the value of theta, other than for being an upper bound to check for the reasonability of the estimated value.

1055. However, the Authority is of the view that it is appropriate to consider this approach when a revised approach responds to the Tribunal's criticisms <u>and</u> satisfies the Authority's criteria as mentioned in its Consultation paper such as being transparent and robust becomes available in the future. Such a study is not available at the moment. As such, the Authority is unable to utilise this source of evidence in deriving the estimated value of gamma.

[465] Australian Competition Tribunal, Application by Energex Limited (Distribution Ratio (Gamma)) (No 3) [2010] ACompT 9 (24 December 2010), paragraph 4.

14.5.3.2 Dividend drop-off method

1056. The Authority is of the view that dividend drop-off method is the most common method to derive the estimate value of theta in Australia. However, there are some estimation issues attached to this method as previously discussed.

1057. As a consequence, the Authority is of the view that it is more appropriate to use a range of dividend drop-off studies. Given significant changes in the year 2000/01, as set out in Vo et al (2013) the Authority considers it appropriate to use post-2000 studies only.[466]

14.5.3.3 Simultaneous security price method

1058. The Authority agrees that simultaneous price studies may be appropriate for the purpose of estimating the appropriate value for theta. However, the Authority is only aware of a single such study having been undertaken in Australia. However, the Authority considers that this study only examined a very limited number of derivative contracts, the estimate of theta from this study cannot be a representative estimate of the market value of franking credits for the Australian financial market.

14.5.4 Adjustment of gamma into the rate of return

1059. The Authority notes there are three separate sub-issues raised by SFG under this key issue.

1060. *First*, SFG submitted that market professionals make no adjustment for imputation credits when estimating WACC or when valuing firms. Consistent with its previous decisions, the Authority had considered the advice of McKenzie and Partington (2010)[467] to the AER on the issue. McKenzie and Partington advised that the 2008 Truong, Partington and Peat study[468] found that the majority of firms do not account for the value of imputation credits because it is too difficult to do so. In addition, this study also finds that only 6 out of 89 firms surveyed cited that the reason they did not incorporate a value for gamma was because they considered that imputation credits have zero market value.

1061. In addition, on the advice to the AER, Handley[469] states that, under the conventional approach to valuation (i.e. no imputation credits), Australian firms and independent valuation practitioners recognise that there is no explicit recognition of the value of imputation credits in either the cash flows or in the discount rate. As such, imputation credits are not assumed to have zero value but rather they are simply not explicitly taken into account in either the cash flows or in the discount rate.

1062. Based on the above considerations, together with the fact that imputation credits have value to investors and the presence of domestic investors in the regulated

[466] Vo, D., Gellard, B., Mero, S. (2013) '*Estimating the Market Value of Franking Credits, Empirical Evidence from Australia' Conference Paper*, *Australian Conference of Economists 2013.*

[467] McKenzie and Partington, Report to the AER, Evidence and submissions on gamma, 25 March 2010, pp. 27-28.

[468] G. Truong, G. Partington and M. Peat, 'Cost of capital estimation and capital budgeting practices in Australia', *Australian Journal of Management*, Vol. 33, No. 1, June 2008.

[469] Handley, Report prepared for the Australian Energy Regulator on the estimation of gamma, 19 March 2010, pp. 3-4.

Australian utilities, the Authority is of the view that setting the value of gamma to zero is not appropriate.

1063. *Second*, the issue is related to the "grossed up" and the "reverse of the grossed up" taking into account the value of imputation credits. The Authority is aware that A/Professor Handley, the AER's consultant, had responded to this concern.[470] A key response can be briefly summarised below.

1064. Handley[471] distinguished two types of cost of equity. The conventional cost of equity represents the "*after-company-after-some-personal tax*" cost of equity, because company profits have been taxed before they are paid out as dividends to shareholders. The grossed-up cost of equity represents the "*after-company-before-personal tax*" cost of equity because the payment of imputation credits removes the effect of taxation on company profits that are eventually paid out as dividends. As such, the investor will not be double taxed on their dividend returns – the imputation credits paid can be collected from the tax office either as an offset or a tax refund.

1065. The conventional cost of equity is formulated as:

$$r_e^{adjusted} = r_e \ x \left[\frac{1-T}{1-T(1-\gamma)} \right] \tag{26}$$

where

r_e is the grossed-up cost of equity

1066. Handley demonstrated that if the change to the grossed-up cost of equity is correctly incorporated, an increase in gamma would also increase both the grossed-up cost of equity and the conventional cost of equity.[472]

1067. *Third*, SFG submitted that the same value of gamma (more specifically, the payout ratio) must be used consistently in the entire process of the rate of return estimation process.

1068. Handley's advice to the AER[473] indicated that two classes of empirical evidence were relied upon:

1069. First, U.S. dividend yield studies provide evidence that dividends are "fully valued" – cash dividends are valued at 100 cents per dollar. This means that differential taxes have no effect on prices, and so differential taxes do not need to be taken into account in estimating equity returns.

1070. Second, U.S. dividend drop-off studies provide evidence that dividends are "less than fully valued", which means that cash dividends are valued at less than 100 cents in the dollar (due to the impact of differential taxes), and so differential taxes do need to be taken into account in estimating gamma.

[470] Handley, Report prepared for the Australian Energy Regulator on the estimation of gamma, 19 March 2010, p. 10.

[471] Handley, Report prepared for the Australian Energy Regulator on the estimation of gamma, 19 March 2010, p. 10.

[472] Handley, Report prepared for the Australian Energy Regulator on the estimation of gamma, 19 March 2010, p. 21.

[473] Handley, Report prepared for the Australian Energy Regulator on the estimation of gamma, 19 March 2010, pp. 24-5.

1071. As such, Handley was of the view that the AER, in its 2009 WACC Review, is relying on the appropriate evidence in the appropriate context (i.e. U.S. dividend yield studies in relation to the CAPM and U.S. drop-off studies in relation to gamma).

1072. Based on the above considerations, consistent with its previous decisions, the Authority is of the view that there is no inconsistency when the estimates of the value of cash dividends are used differently: (i) less-than-100 cents per dollar when theta (then gamma) is estimated and (ii) 100 cents per dollar when return on equity is estimated.

14.6 Draft Guidelines

1073. The Authority considers that the dividend drop- off methodology is the most appropriate methodology for estimating theta, despite its shortcomings and methodological issues. In addition, the Authority is of the view that the best way to estimate theta involves using a number of dividend drop-off studies so as to avoid problems that may arise if only one study is considered.

15 Inflation

1074. Inflation is defined as the rate of change in the general level of prices of goods and services. This impacts the prices set in regulated entities, in particular, the prices of gas distribution and transmission networks. As a consequence, a reliable method is required to estimate the expected inflation rate that will prevail over the next 5 years of the relevant access arrangement.

1075. The expected inflation rate is an input in nominal regulatory modelling. It is used to inflate present values over the regulatory period to arrive at nominal values of the regulated capital base and tariffs in future years within the period. These values reflect an estimate of prices that will prevail at each point in time within the period.

1076. A nominal rate of return incorporates a 'real' rate of return as well as a rate that reflects expectations of inflation. The latter rate is incorporated to protect the real rate of return from being eroded by future inflation. The nominal rate of return must be used to calculate the nominal dollar value of future returns on capital and discount these cash flows back to the present values.

1077. In line with the requirements of the NGR, the Authority will utilise a nominal vanilla rate of return for its future decisions. The rate of return will be estimated from nominal estimation methods, financial models, market data and other evidence.

1078. However, the Authority considers that the expected rate of inflation will remain an important parameter for its determinations. This is because the expected rate of inflation will be required:

- for the roll forward of the regulatory asset base, and for indexing purposed to determine annual depreciation allowances; and
- to adjust the nominal building block allowances in the tariff variation mechanism, to account for actual inflation.

1079. The expected rate of inflation will also allow stakeholders to determine the real rates of change in tariffs, as well as the real rate of return, which is an important contributor to the real changes in tariffs.

15.1 Current approaches to estimating the expected inflation rate by the Authority and other regulators

1080. The Authority currently uses the Treasury bond's implied inflation approach in order to estimate the inflation rate expected to prevail over the course of a regulatory control period. This approach derives an expected inflation via the nominal risk-free rate and the real risk-free rate in which the risk-free rate is proxied by the observed yields on Commonwealth Government Securities (**CGS**).

1081. In this approach, the expected inflation rate is derived using the Fisher equation and observed yields of 5-year CGS (the nominal risk-free rate) and 5-year indexed Treasury bonds (the real risk-free rate).[474,475]

1082. Linear interpolation is then used to derive both the nominal 5-year risk-free rate and the real 5-year risk-free rate.[476] A 20-day moving average of the nominal risk-free rate and the real risk-free rate is used.

1083. The method assumes efficient pricing of the Treasury's indexed bonds in that observed yields must reflect the value that the market places on these instruments at that instant in time. The period around the Global Financial Crisis 2008-2009 saw a decrease in liquidity for Treasury's indexed bonds. Lack of frequent trading meant that observed yields were not likely to reflect efficient pricing. As a consequence, the Authority discontinued the use of this methodology in its regulatory decisions post 2009.[477] In recent years, however, the liquidity of the Treasury's index bonds has improved,[478] and the Authority has again adopted this approach in deriving the estimate for expected inflation over the next regulatory control period.

1084. In addition to the liquidity issue, it has also been suggested that a bias exists due to investors demanding an inflation premium to compensate for being exposed to the uncertainty of the future inflation rate.[479]

1085. Another limitation of this approach is the relatively small quantity of Treasury's indexed bonds on issue, with maturities every five years.[480] This is in contrast to the large quantity of CGS currently on issue. As a consequence, the interpolation of Treasury's indexed bonds is significantly less accurate than the corresponding interpolation for CGS.

1086. The Authority has in its past determinations matched the term of the expected rate of inflation with that of the risk-free rate in order to ensure consistency within the WACC parameters. As such, the term of the expected inflation is also 5 years.

1087. Table 33 below presents the current Australian regulatory practices which are used to derive the expected inflation rate.

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474 The formal fisher equation is: $1+i=(1+r)(1+\pi^e)$

Where: *i* is the nominal interest rate, *r* is the real interest rate and π^e is the expected inflation rate.

475 ERA (September 2012) Final Decision, *Proposed Revisions to the Access Arrangement for the Western Power Network*

476 It is unlikely to find a CGS bond with an expiry date that exactly matches that of the regulatory period end. As such, two bonds are selected that fall on either side of the end day of a regulatory period. The dates on these bonds are referred to as the 'straddle' dates. Linear interpolation estimates the yields on the regulatory period end date by assuming a linear increase in yields between the straddle dates on the two bonds observed.

477 Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p.158.

478 Email and Telephone Correspondence with the Australian Office of Financial Management , 24 and 25 July 2012

479 The Australian Treasury (August 2012) *Measuring market inflation expectations*

480 Reserve Bank of Australia (March 2012) *Extracting Information from Financial Market Instruments*

Table 33 Estimating the expected Inflation rate in the Australian regulatory decisions

Regulator	Year	Industry	Methodology	Term of expected inflation
ACCC[481]	2011	Fixed Line Services (Telecommunications)	RBA Inflation forecast method.	10 Years
AER[482]	2012	Gas Distribution Network	RBA Inflation forecast method.	10 Years
ERA[483]	2012	Electricity Distribution/Transmission	Treasury Bond Implied Inflation method.	5 Years
ERA[484]	2011	Gas Transmission	RBA Inflation forecast method.	5 Years
IPART[485]	2012	Water, sewerage, stormwater drainage and other services	Implied Inflation via Inflation swaps	10 Years[486]
QCA[487]	2012	Water, sewerage, stormwater drainage and other services	Midpoint of RBA Inflation Target Range (2.5%)	5 Years
ESCOSA[488]	2012	Water, sewerage, stormwater drainage and other services	Treasury Bond Implied Inflation method.	10 Years

Source: Compiled by the Economic Regulation Authority

15.2 The Alternative Methods

1088. An alternative market based measure of inflation expectations via observing the fixed rate of zero-coupon inflation swaps has been suggested to overcome the problems associated with the CGS approach.[489 490]

481 Australian Competition and Consumer Commission, *Inquiry to make final access determinations for declared fixed line services — Final report*, July 2011, p. 34.

482 Australian Energy Regulator, *Access Arrangement final decision Envestra Ltd 2013-17 Part 1,* March 2013, p. 30.

483 Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

484 Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p.158

485 Independent Pricing and Regulatory Tribunal, *Review of prices for Sydney Water Corporation's water, sewerage, stormwater drainage and other services, From 1 July 2012 to 30 June 2016*, p.205.

486 Independent Pricing and Regulatory Tribunal, *Adjusting for expected inflation in deriving the cost of capital, Analysis and Policy Development – Final Decision*, 1 May 2009 p. 6.

487 Queensland Competition Authority, *Final report, Sunwater irrigation price review 2012–17, Volume 1, May 2012*, p. 201.

488 Essential services commission of South Australia, *Advice on a regulatory rate of return for SA Water—Final advice*, February 2012, p. 9.

489 The Australian Treasury (August 2012) *Measuring market inflation expectations.*

490 Reserve Bank of Australia (March 2012) *Extracting Information from Financial Market Instruments.*

1089. A zero-coupon inflation swap is a contract which involves 2 parties who agree to exchange cash flows determined by the rate of inflation at the end of the contract. One party agrees to pay a fixed rate specified at the start of the contract, whilst the counterparty agrees to pay the realised rate of inflation at the end of the contract. In principle, only the difference between the two rates is paid. The payments are calculated by multiplying the difference in the two rates by the nominal value of the contract.

1090. Inflation swaps are quoted in terms of the fixed rate a dealer is either willing to pay or receive in order to enter into the agreement. The midpoint of these two rates is seen to be the market's inflation expectation over the term of the contract.

1091. Inflation swap rates are not subject to the liquidity premium that impact bond markets due to the fact they are over-the-counter contracts. In addition, whilst inflation swap rates may incorporate a premium for counterparty risk, it is likely to be small due to the legal protection of the agreements in the event of a counterparty default and the fact that premiums are not exchanged.[491]

1092. Inflation swaps carry an inflation premium similar to that found in CGS.[492] The inflation premium is compensation for the volatility of the realised inflation rate over the term of the swap. In addition, increased banking regulations, requiring banks to hold larger capital against derivative exposures has added a premium to the inflation swap rates. In addition, hedgers are likely to pay a premium over the expected inflation rate in order to reduce their exposure to the inflation rate As such, there may be an upward bias component in the fixed inflation swap rate.

1093. An alternative approach used by the Authority and other regulators in previous decisions is the "Inflation forecast" method.[493] This approach estimates expected inflation rate by utilising the Reserve Bank of Australia's (**RBA**) Consumer Price Index (**CPI**) forecast from its most recent Statement on Monetary Policy for each period available. Where an explicit forecast is not available, the midpoint of the RBA's inflation target is utilised for the remaining periods.[494] The expected inflation rate over the regulatory period is estimated using the geometric mean of each of these expected inflation rates.

1094. In its Final Decision for Western Power's proposed access arrangement, the Authority noted that using the RBA inflation forecast method resulted in a negative real risk-free rate when Fisher's equation is used.[495] The Authority considered that an expected negative real risk-free rate is incorrect, as investors would be unwilling to lend funds with an expected negative real rate of return, when withholding investment offers a 0 per cent rate of return.

1095. This negative expected real rate of return may have been the result of the RBA overestimating the expected inflation rate. Given the nominal risk-free rate observed from the market in conjunction with the inflation forecast from the RBA

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491 Hurd,M. And Rellen, J. 2006, *Net information from inflation swaps and index-linked bonds,* Quarterly Bulletin, Bank of England, Spring, p. 29.

492 The Australian Treasury (August 2012) *Measuring market inflation expectations.*

493 Economic Regulation Authority, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline*, 31 October 2011, p.158.

494 The RBA's current inflation target is within a 2-3 per cent band, resulting in a mid-point of 2.5 per cent.

495 Economic Regulation Authority (Western Australia), *Final decision on proposed revisions to the access arrangement for Western Power*, 2012 p. 328.

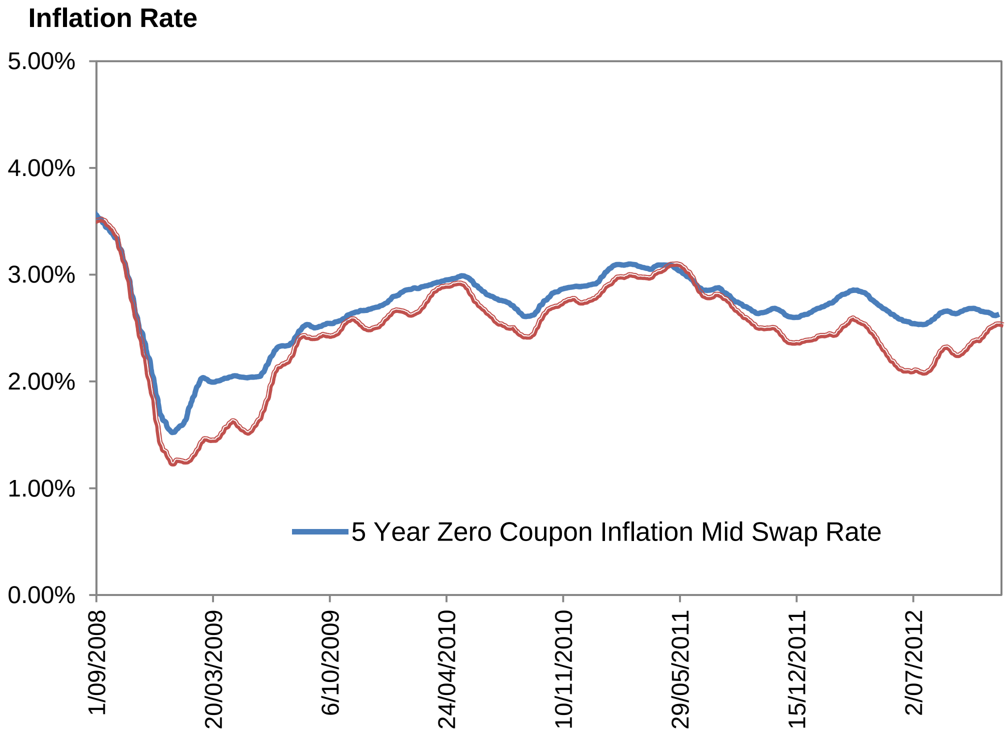
and applying this to the rearranged form of the Fisher's equation, resulted in a negative real risk risk-free rate.[496]

1096. The Authority noted that during this period, the liquidity of the Treasury's indexed bond market had improved substantially. As such, the Authority was of the view that the expected inflation rate was best estimated using the observed yields of the CGS and the Treasury's indexed bonds.

15.3 Considerations of the Authority

1097. The Authority has conducted its own analysis to identify any differences in the expected inflation rate derived from the "Treasury's indexed bond" approach and the "inflation swap" approach. The first approach is to estimate the expected inflation rate derived by using Fisher's equation from the observed yields on CGS and Treasury's indexed bonds. This was estimated using the 20-day average of both CGS and Treasury's indexed bonds prior to the required date. The second approach is to take into account the expected inflation rate implied from the mid rate of the interest rate swaps using a 20-day average prior to the required date. Figure 22 below demonstrates the estimated expected inflation rate using both approaches.

Figure 22 Expected Inflation estimated from Treasury's Indexed Bonds and Inflation Swaps



Source: Bloomberg, RBA and ERA analysis.

[496] The Fisher equation solved in terms of the real risk free rate is: $r = \frac{(1+i)}{1+\pi^e} - 1$. A negative real risk free rate of return will occur if the expected inflation rate exceeds the nominal risk free rate, $\pi^e > i$.

1098. The divergence between the implied inflation rate of bonds and the zero-coupon swap rate is most evident during the period from December 2008 to July 2009, as presented in Figure 22. As noted previously, this divergence is largely due to the liquidity premium for the Treasury's indexed CGS and the "flight to quality" towards the CGS, creating a significant bias in the implied inflation expectation. As the fixed inflation swap rate is determined by the market's inflation expectations, this bias was not present in the implied inflation rate from zero-coupon inflation swaps. It is noted that the approach using observed yields on the Treasury's index bonds was not adopted by Australian regulators to derive expected inflation during the above period due to concerns regarding illiquidity.

1099. Given liquidity is no longer an issue for the Treasury's indexed bonds, the Authority considers that estimating the expected inflation rate using the observed yields of the CGS and of the Treasury's indexed bonds, then using the Fisher's equation to estimate the implied inflation rate, is the most accurate measure of inflation expectations.

1100. The rationale for utilising this approach is that market prices reflect the aggregation of diverse market participant's expectations. The forecasts of many different market participants' is considered to contain more information and be more relevant than any one particular forecast model or limited set of models. There is some evidence that this is the case in the Australian markets.[497]

1101. The Authority prefers the current approach as adopted in the Final Decision on Western Power's proposed access arrangement in deriving an expected inflation. It is because this approach utilises both nominal and real risk-free rates which are directly observed from the market. As a consequence, these estimates will reflect the market's expectation of the expected inflation rate.

1102. The Authority considers that the inflation swap approach contains a significant upward bias, which does not accurately reflect investor's inflation expectations. As Figure 22 demonstrates, the expected inflation rate derived from the inflation swap market is consistently higher than that of the implied inflation rate using the Treasury's indexed bonds approach. The Authority is of the view that this upward bias is more prevalent in inflation swap markets due to hedgers paying a premium when entering into an inflation swap. This implies that they expect to pay a higher rate than the expected inflation rate. As such, using the implied inflation rate from the swap market is likely to overestimate the expected inflation rate.

15.4 Draft Guidelines

1103. The Authority considers that its current approach is appropriate for deriving expected rates of inflation. In this approach, both nominal and real risk-free rates of return are directly observed from the financial markets. As such, these estimates reflect the market expectation for inflation.

1104. However, the Authority is aware that under some circumstances this approach may fail. For example, during the recent global financial crisis when there were liquidity concerns in the Treasury's indexed bonds market which lead to a bias in the estimate of a real risk-free rate. In such circumstances, another approach such as the RBA's Inflation Forecast approach method may be preferred.

497 Singh, R, 1993, *Response of Stock Prices to Money Supply Announcements: Australian Evidence*, Accounting & Finance, Vol 33, p. 51.

1105. The Authority will estimate the expected inflation rate consistent with the estimate of the risk-free rate by adopting an averaging period of 20- trading days prior to an access arrangement. In addition, the term of the expected inflation rate is also 5 years, which is consistent with the terms of the risk-free rate of return and the cost of debt.

Appendix 1 Glossary

Acronym	Full text
ACCC	Australian Competition and Consumer Commission
ACT	Australian Competition Tribunal
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ATCO	ATCO Gas Australia
DBP	Dampier Bunbury Pipeline (and DBNGP (WA) Pty Ltd)
DRP	Debt Risk Premium
ENA	Energy Networks Association
EUAA	Energy Users Association of Australia
GGT	Goldfields Gas Transmission
IPART	Independent Pricing and Regulatory Tribunal (of NSW)
MRP	Market risk premium
WAMEU	Western Australian Major Energy Users Inc
NER	National Electricity Rules
NEL	National Electricity Law
NEM	National Electricity Market
NGL	National Gas Law
NGO	National Gas Objective
NGR	National Gas Rules
NSW T Corp	New South Wales Treasury Corporation
QTC	Queensland Treasury Corporation
RAB	Regulatory Asset Base
RPP	Revenue and Pricing Principles (Section 24 of the NGL)
SFG	Strategic Finance Group Consulting
WACC	Weighted average cost of capital

Appendix 2 The Present Value Principle

1. In a regulated environment in which output prices are set or capped, the present value of the revenue earned from an asset must be equal to the initial investment to ensure that the total costs incurred are recovered. If no more than or no less than the total costs are recovered, in discounted terms, then the net present value is zero (NPV=0).

2. It is argued that setting the terms of the proxies for the risk free rate and the cost of debt to match the regulatory control period – which is generally five years in Australia and New Zealand – will satisfy the "NPV=0" principle. This view is supported by a range of studies, each of which is summarised briefly in what follows.

3. First, under the assumption that future interest rates are the only source of uncertainty and that the company is financed entirely by equity, Marshal et al. (1981) concluded that the period associated with the risk-free rate should match the regulatory period. These authors argued that if this principle is not satisfied, then equity holders are either over or under compensated by the regulator.

4. Schmalensee (1989)[498] also assumed that there is no debt and no source of risk other than the uncertainty of the future risk free interest rates. The authors concluded that the term of the risk free rate and the term of the debt margin should be matched with the regulatory control period to ensure that equity holders are not under- or over-compensated.

Lally's analysis

5. Lally (2004) relaxed the above assumptions by considering cost and demand shocks, and risks arising from depreciation methods in which the aggregate depreciation allowed by the regulator may diverge from the cost of the assets. However, in this study, Lally continued to make the same assumption that the firm is to be totally financed by equity. The author concluded that if the risk-free rate is revised at the end of each regulatory cycle, in accordance with the prevailing rate, then the appropriate rate should be that matching the regulatory period.[499]

6. In the 2004 paper, Lally explores the consequences of matching the rate of return and the regulatory cycle.[500] In this paper, Lally constructs a model of the regulatory cycle where a regulated project is initiated at time 0 with a life of T years. It is assumed that revenues arise at times 1,2, ... T years, with output prices being set by the regulator at time 0, with revisions occurring at time 1,2, ... T-1 years. Lally notes that the assumption of a one-year regulation cycle is for convenience only, and that results derived will hold under any regulatory cycle length. Lally assumes that operating costs and demand levels are uncertain.

7. Using this framework, Lally implicitly assumes that the allowed rate of return is revised at the end of each regulatory cycle and that the assets activities are

[498] Schmalensee R., 1989, "An Expository Note on Depreciation and Profitability Under Rate-of-Return Regulation", *Journal of Regulatory Economics*, Volume 1, No.3, pp. 293-298.

[499] Lally M. 2004, "Regulation and the Choice of the Risk Free Rate", *Accounting Research Journal*, Volume 17, No. 1, 2004, pp. 18-23.

[500] Lally M. 2003, "Regulation and the Choice of the Risk Free Rate", *Accounting Research Journal,* Volume 17, No.1, 2004, pp. 18-23.

entirely equity financed. Lally utilises the building block approach to set the output price allowed at time t such that the expected revenues realized at time t+1 are equal to the sum of: (i) the expected operating costs at t+1, (ii) the depreciation allowed for the next period; and (iii) an allowed rate of return applied to the book value of assets as follows:

$$E_t(REV_{t+1}) = E_t(C_{t+1}) + DEP_{t,t+1} + BV_t R_t \qquad (27)$$

Where:

$E_t(REV_{t+1})$ is the expected revenue for time t+1 at time t;

$E_t(C_{t+1})$ is the expected operating costs at t+1 at time t;

$DEP_{t,t+1}$ is the depreciation allowed at time t;

BV_t is the book value at time t; and

R_t is the allowed rate of return at time t.

8. Lally argues that the allowed rate of return, R_t, should be set such that the present value of the future cash flows equals the initial outlay for investment, as outlined by Marshal et al(1981);[501] and Schamlensee (1989).[502] This condition is equivalent to the NPV=0 principle used by Australian regulators, to ensure that the *present value* of revenue earned by a regulated asset is equal to the initial investment. Lally proves that to satisfy this criterion R_t must equal the prevailing one-period risk-free rate,[503] $R^f_{t,t+1}$ plus an appropriate risk premium, p_t to compensate investors for the demand risk and operating cost risk.[504] Lally does this by demonstrating that under an upward sloping risk-free term structure, a rate of return with a longer maturity than the regulatory cycle leads to revenues being too large; violating the "NPV=0" principle. In the converse situation, with a downward slopping risk-free term structure, a shorter maturity results in revenues being too small to cover the expected costs, again violating the NPV=0 principle. Lally thus concludes that the appropriate rate of return required under a regulatory environment is one where the risk-free rate matches the term of the regulatory period.

9. Lally (2007) extends this study by relaxing the assumption of all equity financing, by allowing for the regulated entity to be partially financed by debt, with the firm having the option of being able to choose the duration of its debt financing.[505]

10. The purpose of this study was to consider the implications of the regulated firm being at least partly debt financed, as well as the possibility of the firm choosing a

501 Marshal, W., Yawitz, J. And Greenberg, E. (1981), 'Optimal Regulation Under Uncertainty', *The Journal of Finance,* vol 36, pp. 909-22.

502 Schmalensee, R. (1989), 'An Expository Note on Depreciation and Profitability Under Rate-of-Return Regulation', *Journal of Regulatory Economics,* vol.1, pp. 293,298.

503 *One period in this context refers to the length of the regulatory period.*

504 *Given the all equity financing assumption, Lally suggests that the appropriate risk premium p_t reflects the systematic cost and demand risks as suggested by Capital Asset pricing theory.*

505 Lally M. 2007, "Regulation and the Term of the Risk Free Rate: Implications of Corporate Debt", *Accounting Research Journal,* Volume 20, No.2, 2007, pp. 73-80.

duration for this debt finance that diverges from the length of the regulatory cycle. Lally concluded that the NPV = 0 principle is only satisfied on the following two conditions: (i) the terms of the risk free rate and the debt risk premium must be set equal to the regulatory control period; AND (ii) the regulated businesses choose their borrowing to match the regulatory cycle. Lally also concluded that departure from either of these conditions will lead to violations of the NPV = 0 principle.[506]

11. Lally agreed that these findings do not consider any re-financing risk – the risk arising due to the exposure to unusual conditions in the debt markets at the time the debt needs to be refinanced. In response to this potential problem, Lally argued that a company may seek to stagger the roll-over of the debt in such a way that the same proportion – which is relatively small – is to be refinanced each year. Lally argued that the company's actual schedule of debt can be converted into the schedule that aligns with the regulatory control period using swap contracts available in the market (interest rate swaps would be used to deal with the risk free rate of return component and credit default swaps would deal with the debt premium).

12. Lally begins the analysis by assuming that the only source of risk is changes in the risk-free rate, from which he concludes the firm's cost of debt is equal to the risk-free rate. In addition, Lally adopts a framework of assuming a regulatory cycle of one year, output prices being set at the beginning of the year with revenue arising from this at the end of the year, the regulated asset has a life of 2 years and there are no operating costs associated with the regulated asset. Additionally, Lally assumes a constant gearing of L in book value terms which the firm constantly maintains.

13. Lally outlines 4 scenarios that represent the firm's and regulator's choices under this framework, given that firms have 2 debt strategies (two-year debt[507] or one-year debt with rollover after one year[508]) and the choice of the regulator to using the one-year risk-free rate[509] or the residual life of the asset.[510] Lally outlines the consequences for the "NPV=0" concept under each scenario. Table 34 shows the scenarios as named by Lally:

[506] Lally M. 2007, "Regulation and the Term of the Risk Free Rate: Implications of Corporate Debt", *Accounting Research Journal*, Volume 20, No. 2, 2007, pp. 73–80.

[507] This situation reflects firms matching the maturity of their debt and the remaining life of the regulated asset.

[508] This situation reflects firms matching the maturity of their debt and the length of the regulatory period.

[509] Reflecting that the term to maturity of the risk free rate should equal the regulation period.

[510] Reflecting that the term to maturity of the risk free rate should match the life of the regulated asset.

Table 34 Scenarios outlined by Lally (2007)

	Firm debt maturity matches regulatory period	Firm debt maturity exceeds regulatory period
Regulator awards return with maturity that matches the length of the regulatory period	Policy 1	Policy 3
Regulator awards return with maturity that exceeds the length of the regulatory period	Policy 2	Policy 4

14. Utilising this framework, Lally proves that **only** under Policy 1 does the present value of cash flows equal that of the initial investment, satisfying the NPV=0 criterion. Lally notes that this analysis is a simplified version of reality, in that it considers only interest rate risk in the risk-free rate. Lally notes that a firm may in reality choose a shorter debt maturity than the regulatory period if it expects its credit rating to improve, or may choose a longer maturity debt to reduce "re-contracting risk", the risk that the debt margin will change in the future. Lally notes that recontracting risk only exists if regulators award efficient costs, and not actual costs.

15. Extending the previous framework, Lally now assumes that regulators award a debt risk premium of *p*, with this premium assumed to match the actual debt risk premium incurred by the firm, for both one-year and two-year debt. However, after one year, the premium awarded by the regulator is constant but the actual debt risk premium incurred by the firm (on any newly issued debt) is allowed to differ (denoted as p_1). This updated framework therefore allows for the existence of recontracting risk, as p_1 is allowed to differ from *p.*

16. Lally explores each scenario in Table 34 with the possibility of refinancing risk and shows that only under Policy 1 is the "NPV=0" principle satisfied. Lally also shows that whilst longer term debt can reduce equity holder's exposure to refinancing risk, it increases their exposure to interest rate risk. Lally therefore concludes that if firms are able to fund their assets via a combination of debt and equity, with the existence of re-contracting risk and interest rate risk, the NPV=0 is satisfied under 2 conditions: (i) The term of the risk-free rate and debt risk premium match the regulatory period; and (ii) The regulated business choose to match their debt maturity with that of the regulatory period.

17. More recently, Lally (2010) has argued that where the average debt term used by regulated businesses materially exceeds five years (that is, the term of the regulatory cycle), and where these firms use neither interest rate swaps nor credit default swaps to convert the longer term (say 10-year) debt into the five year debt, then the "NPV = 0" principle would be violated. This is because the allowed costs would diverge from those actually incurred by the firms.[511]

[511] Lally M. 2010, *The Appropriate Term for the Risk Free Rate and the Debt Margin,* April, p.14.

18. In this 2010 paper, Lally notes that the reasoning adopted in his 2004 and 2007 papers ignores any consideration of "refinancing risk", the risk of exposure to unusual conditions in debt markets at the time of refinancing. This refinancing risk can occur due to no debt financing being available at any price, and credit providers exercising market power due to a firm requiring its entire debt portfolio to be rolled over at once.

19. Lally's proposed solution was to introduce a staggering or roll-over of a firm's debt portfolio over the regulatory period, with a proportion being refinanced each year. Lally suggested that to ensure a company's debt schedule matched that of the regulatory control period, interest rate and credit default swaps could be used to ensure they are equal. Lally proposes 4 options with which to deal with refinancing risk.

20. *The first option* proposes that the benchmark efficient firm refinances its debt portfolio every regulatory control period.[512] Lally suggests that the total cost of debt would therefore be made up of: (i) the five-year risk-free rate, (ii) five-year debt risk premium; and (iii) an annualised debt issuance cost of a five-yearly debt issue. Lally notes that this approach will satisfy the "NPV=0" but implicitly assumes that the incremental refinancing risk from using five-year debt as opposed to any alternative is inconsequential.

21. *The second option* suggested by Lally assumes that regulated firms borrow for 10 years, but utilise swap contracts to match the 5-year regulatory period. Consequently, the regulator would award a cost of debt that would include: (i) a five-year risk free rate, (ii) annualised 10-year debt issuance costs, (iii) five-year debt risk premium; and (iv) the transaction costs involved in swap contracts. Lally suggests that as refinancing risk is not compensated for by the regulator, borrowing for the longer term may be considered an efficient strategy. Lally notes that this approach will satisfy the NPV=0 principle if credit default swaps are available for the regulated entity.

22. Lally proposes *a third scenario* to deal with the lack of credit default swaps. In this situation, it is assumed that the regulated firm will borrow for a tenure of 10 years and use interest rate swaps to convert the ten-year risk-free rate to a five-year risk free rate. Given the difficulties with using credit default swaps to convert a 10-year debt risk premium to a 5-year one, Lally suggests using: (i) the five-year risk-free rate, (ii) 10-year debt risk premium, (iii) annualised 10-year debt issuance costs; and (iv) the transaction costs involved with swap contracts. Whilst this would violated the NPV=0 principle, Lally suggests that this would be a slight deviation of approximately 0.04% of the WACC per year.

23. *The fourth option* assumes that both interest and credit default swaps are unavailable, and as a consequence the total cost of debt should be made up of: (i) the ten-year risk-free rate, (ii) ten-year debt risk premium; and (iii) annualised debt issuance costs across a 5-year regulation period.

24. Lally notes that in both scenario 3 and 4, the divergence from NPV=0 is likely to result in either a positive or negative Net Present Value. In his advice to QCA, Lally dismisses option 4 on the basis that it is unrealistic that the benchmark efficient firm would seek to hedge the mis-match between their borrowing term and the length of the regulatory cycle.

[512] Ibid.

25. Lally does not advocate any given option in his advice, but outlines the conditions under which each scenario should be chosen.

26. Lally suggests scenario 1 should be used if the average debt term of comparable firms is not significantly larger than 5 years. Lally suggests that a higher average term to maturity for debt is indicative of firms being significantly concerned with refinancing risk.

27. In the situation where the average term to maturity is significantly longer than 5 years, Lally advocates scenario 2 if credit default swaps are readily available and transaction costs are not significant. If transaction costs are significant, or credit default swaps are not readily available then Lally advocates the third option.

Davis's analysis

28. In his advice to the ACCC, Davis advocates strongly the use of a risk-free rate of return that matches the length of the regulatory period.[513] With respect to the cost of debt, Davis suggests that the cost of debt figure used by regulators should equal the expected return required by investors in debt securities. Davis notes that regulated entities often assert that an efficient financing strategy involves an entity raising debt with a maturity close to the expected life of the asset or minimising transaction costs and risk when refinancing a debt portfolio. Davis suggests that this argument is invalid due to the ability of regulated entities to change the characteristics of debt instruments via the use of either floating rate debt or interest rate swaps.

29. Davis suggests that the calculation of a longer maturity debt risk premium is invalid given that the building block framework used by Australian regulators involves recalculation of allowable cash flows at the end of a regulatory reset, which in turn takes into account the market wide debt risk premium applicable at that date. Davis states that therefore, the argument for "locking in" a credit spread that is not subject to market's wide movements is not valid. Davis argues that given that the allowable cash flows adjust, this acts as a hedge to this source of risk. Davis notes that it is possible that a credit rating adjustment might occur, which is an issuer's specific component of the credit spread. Davis argues that this is a risk that is equally likely to be an upside/downside risk to the regulated entity and one that is reduced at the regulatory reset. Davis summarises his arguments that if the regulatory authority provides an allowance in determination for debt issuance costs and rollover costs, the regulated entity is compensated for the higher costs of short term debt issuance and the applicable term for the cost of debt is that of the regulatory period.

Implications

30. The implications for the term of the return on equity and the return on debt are discussed in what follows.

Return on equity

31. The Authority proposes to adopt the Sharpe Lintner CAPM for the purpose of estimating the return on equity. The return on equity under the Sharpe Lintner

[513] Davis K 2003 *Risk Free Interest Rate and Equity and Debt Determination in the WACC, prepared for the ACCC*, pp. 11-12.

CAPM is derived from the sum of an estimate of the risk free rate and an estimate of the market risk premium.

32. The estimates are forward looking.

33. The risk free rate would be based on the five year risk free rate 'on-the-day' prevailing at the start of the regulatory period.

34. The market risk premium would be estimated based on four different approaches:

- an estimate of the historical equity risk premium over the longest possible period;
- surveys of market risk practice;
- qualitative information on Australian financial markets around the time of the decisions; and
- other Australian regulators' current practice.

35. The first approach above, the estimate, is derived as:

- the sample of historic observations of the total market return; from which
- the relevant five year risk free rate would be netted off to give the market risk premium.

36. The Authority considers that these approaches would be consistent with the Lally/Davis NPV=0 principle.

Return on debt

37. For the return on debt, the Authority proposes to adopt the on-the-day approach to estimating the cost of debt, reflecting the prevailing conditions. The estimate would comprise the sum of the risk free rate and the debt risk premium.

38. For the risk free rate, the five year risk free rate is the relevant term. Analysis of current debt profile of regulated businesses indicates that the term to maturity of their entire debt portfolio is on average approximately five years, and that regulated firms aim to maintain this term when issuing new tranches of debt. As a result, the Authority considers that the appropriate term for the risk free rate, and also the debt risk premium, should be five years.

39. The Authority proposes that this be updated annually.

40. It is proposed that the annual update would only be applied to the risk free rate embedded in the cost of debt. The debt risk premium derived from the Authority's bond yield approach would remain unchanged during the control period of five years. Doing so would provide regulated businesses with greater capacity to rely on floating rate notes, which account for almost 50 per cent of the total bonds issued by regulated businesses in Australia.

Outcome for the risk free rate

41. Under the proposed arrangements, even where the regulated businesses has issued fixed rate notes to fund its debt, it could track the regulated five year risk

free rate, updated annually, through undertaking of interest rate swaps.[514] This would enhance economic efficiency, as there would be an alignment between the prevailing cost of debt and the utility's actual cost of debt (see Appendix 4 for the Authority's views on efficiency relating to the cost of debt).

42. The Authority considers that this "locking" in of the underlying risk free rate is possible as interest rate swaps are available for the regulatory term of up to five years.

43. To show this, first consider that the entire cost of debt can be decomposed into either: (i) the risk- free rate and the debt risk premium (as in the bond yield approach); or (ii) the bank bill swap rate (**BBSW**) and the debt margin (businesses confirm that they conduct hedging based on the BBSW).[515] The Authority considers that the entire cost of debt is the key focus in the determination of the rate of return. The decomposition of the total cost of debt is less relevant.

44. Second, the Authority is of the view that, as part of prudent debt management, regulated businesses may conduct their hedging around the term of 12 months. The Authority considers that the markets for hedging instruments, including for interest rate swaps and forward rate agreements, are very liquid for the horizon up to around 18 months.

45. To illustrate how the firm would hedge under this approach, assume that the average cost of fixed debt determined from the bond yield approach is 8 per cent. This is comprised of say, a five year risk free rate of 4.5 per cent, and a five year debt risk premium of 3.5 per cent. Then, in order to hedge this outcome, the regulated business could issue a floating rate note based on the 12-month BBSW. In this case, assume that the prevailing 12 month BBSW is 3 per cent, which is significantly lower than the five year risk free rate of 4.5 per cent. Then, in the floating rate note issued by the firm, the fixed debt risk premium component will be 5 per cent, to account for the difference of the total cost of debt (the 8 per cent) and the 12 month BBSW (the pricing tool for hedging purposes, which is 3 per cent). The result is present value neutral, and the regulated business is not under or over compensated.

46. Third, as noted, it is the *five year risk free rate* that would be updated annually. The Authority considers that updating the five year risk free rate annually would facilitate hedging by regulated businesses in the manner outlined above. It would achieve this by aligning the regulated rate with the fluctuations of the floating rate bonds of firms undertaking such hedges.

47. At the same time, the Authority considers that the overall outcome would be consistent with NPV=0 under Lally/Davis. This is because there is no particular advantage under this approach for regulated businesses to issue debt with a term that is shorter than five years, as they would increase their refinancing risk.[516]

[514] It also is possible that the firm could include a callable feature on the floating rate notes, which would allow the regulated business to recall the bonds and issue the new ones if interest rates declined significantly during the life of the bond. Subsequent hedging of these notes to the regulated rate could then occur through the interest rate swaps market, which includes vanilla swaps as well as forward rate agreements.

[515] Chairmont Consulting 2013, *Comparative Hedging Analysis*, www.erawa.com.au, p. 14.

[516] 'Pricing' the five year floating rate debt in this way – using the short term BBSW rate – is to achieve the hedge, not to shorten the overall term of debt.

Outcome for the debt risk premium

48. The debt risk premium will be based on the Authority's bond yield approach. Note that small sample issues imply that it is not possible to readily observe the debt risk premium of bonds with exactly a five year term. The sample of bonds used to estimate the debt risk premium under the bond yield approach has variable tenors, currently giving an average term to maturity of around six years.

49. As hedging instruments, such as credit default swaps, are not readily available in Australia, firms cannot hedge this debt risk premium. Lally observes that where hedging is not available, it is reasonable to adopt the tenor faced by firms for estimating the debt risk premium. This recompenses the firm for the unhedged component, recognising efficient financing practices.

50. However, Lally notes this violates the NPV=0 principle. For example, as the average tenor of the sample bonds in the ERA's bond yield estimate of the debt risk premium is six years, not five years, this is an overestimate in NPV=0 terms.[517] However, Lally's recent analysis suggests that the resulting deviation from NPV=0 would be very small (less than 0.04 per cent on the overall NPV calculation).[518]

51. The Authority notes that the bond yield approach is generous to the utility (but not to consumers). It is based on a sample of bonds with the same credit rating across the whole market. Yet infrastructure firms tend to be at the less risky end of the credit rating bands, so tend to have smaller debt risk premiums than the average within the band.

[517] The over-estimate assumes an upward sloping yield curve.

[518] Lally M. 2010, *The Appropriate Term for the Risk Free Rate and the Debt Margin,* April, p.11.

Appendix 3 Review of criteria for informing regulatory judgment

1. This Appendix reviews the criteria that were set out in the Consultation Paper in light of stakeholder comments.

Principles or criteria?

2. 'Principles' are the fundamental truths that serve as the foundation for laws, systems or reasoning, whereas 'criteria' are the principles or standards by which judgments or decisions can be made.[519] Overall, there appears to be little to distinguish between the two terms.

3. It is worth noting in this context that the AEMC set out in its Final Decision that principles are an important driver in the new arrangements, informing the exercise of judgment and achievement of best practice:[520]

> One of the criteria the Commission has applied to determine the best framework for the NER and the NGR includes allowing methodologies for parameters to be driven by principles and to reflect current best practice.

4. The Authority considers that the use of the separate term criteria would support its clear intent that the criteria are separate and subordinate to the laws, principles and rules set out in the National Gas Law (**NGL**) and the NGR.

5. The Authority does not consider that the term 'considerations' (as suggested by the ENA – refer paragraph 51 above) is appropriate, as the term is defined either with relation to 'careful thought' or to a 'fact or motive' that is taken into account.[521] These elements do not describe what is intended. Raising the status to 'criteria' will provide greater certainty for stakeholders as to the framework that will be used to inform the exercise of regulatory judgment.

6. On balance, the term criteria is used as it:
   - is closely related to the term principle;
   - clearly captures the intent (see below); and
   - creates a clear separation from the superior requirements of the NGL and NGR.

7. Accordingly, the term 'criteria' is used in what follows.

A revised set of criteria

8. Each criterion to be adopted by the Authority is discussed in turn.

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519 See for example, oxforddictionaries.com/definition/english/criterion.

520 Australian Energy Market Commission 2012, *Rule Determination: National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012 National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012*, www.aemc.gov.au, p. 56.

521 See for example, oxforddictionaries.com/definition/english/consideration

Theoretical underpinning

9. The Authority proposed that regulatory judgment should be informed by approaches which 'have a strong theoretical underpinning'. The AER proposed that rate of return methods should be driven by economic principles and have a strong theoretical foundation.[522]

10. This principle was intended to recognise that a theoretical underpinning for an approach to regulation is highly desirable. This desirability was grounded within an interpretation of the NGO and its requirement for regulation to:[523]

> ...promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.

11. Economic theory provides important insights relating to conditions for the achievement economic efficiency, including for the setting of revenue and prices for monopoly networks. Economic theory has also demonstrated how economically efficient outcomes are in the long term interests of consumers. Hence this criteria was intended to draw on these theoretical insights to maximise the likelihood that regulatory outcomes would be consistent with economic efficiency, and thus would best meet the NGO.

12. The AER in its Issues Paper proposed that regulatory discretion be 'driven by economic principles'. This is a broader reference than simply that of economic theory, and is considered a better term for capturing the intent of this principle. Economic principles can be considered to be based on the established scientific method of observation, theory *and* empirical testing.

13. Expanding this criterion from economic theory to encompass economic principles should address the concerns of APIA and DBP, who were concerned that a narrow emphasis on economic theory might 'unnecessarily restrict the types of evidence the regulator would consider[524,525]

14. With regard to this criterion, ENA suggested that:[526]

> The term "economic" is inappropriate either as a description of what these items consists of or as a basis for distinguishing the first group of considerations from the others and the term "driven" is likely to set too high a threshold for these matters to appropriately constitute considerations.

15. The Authority considers that the reference to 'economic' principles is important, as it relates to the achievement of efficiency, as set out above. It is less likely that other methods – that are not grounded in the concept of economic efficiency – would necessarily be as effective in achieving the NGO. With regard to the term 'driven', the Authority does not accept that some softening of this term is appropriate, given the clear support for this approach by the AEMC (refer to paragraph 3 above).

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522 Australian Energy Regulator 2012, *Better Regulation: Rate of Return Guidelines: Issues Paper*, December 2012, www.aer.gov.au/node/18859, p. 11.

523 Western Australian Government Gazette 2009, *National Gas Access (WA) Act 2009*, www.slp.wa.gov.au, p. 76.

524 The Australian Pipeline Industry Association 2013, Rate of Return Review, www.erawa.gov.au, p. 21.

525 DBNGP (WA) Transmission 2013, *Response to the Consultation Paper*, www.erawa.gov.au, Att. 3, Table1

526 Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.gov.au, Att. 1, p. 10.

16. The ENA also considers that this criterion needs to be amended to ensure the avoidance of bias and also to reflect a strong empirical performance:[527]

> (b) there is data available that enables the theory to be practically implemented without significant biases in the overall rate of return decision; and
>
> (c) the methodologies should at their current state of development perform well empirically.

17. The Authority considers that the first point, relating to bias is dealt with under the criterion 'implemented in accordance with best practice' (see below), so is considered further there.

18. The Authority notes that while good empirical performance is desirable, it is unlikely to provide for a strong criterion on its own. This inference reflects the need to avoid the pitfalls of data mining, and the potential for outcomes that are removed from the objective of economic efficiency. As noted above, economic principles require strong foundations in both theory and empirics. For these reasons, it is considered that empirical support, while important, is strongest when it is linked to theoretical support.

19. In summary, the Authority considers that methods that are desirable are:

- Driven by economic principles
  - based on a strong theoretical foundation, informed by empirical analysis.

Are fit for purpose

20. The Authority proposed that rate of return methods that 'are well accepted' would help to deliver the allowed rate of return objective. The intention here was to ensure that there was widespread recognition and acceptability of the method, as this would enhance the credibility and acceptability of a decision.

21. DBP responded directly to the use of this term, stating that:[528]

> "well-accepted" is not a term used in the new rule 87 and is likely to be inconsistent with the rule 87(5)(a) where regard must be had to 'relevant' estimation methods, financial models, market data and other evidence.
>
> It is DBP's view that the regulator would be beyond power if it maintained its establish approach to determining whether a model is 'well-accepted' as it has done under the old rule 87. The pursuit of the most "well accepted" model assumes that one single model can determine a rate of return that is consistent with the objective. The AEMC was at pains in its reasoning in the final Rule Determination to move away from this approach in the new NGR.

22. However, the Authority does not accept that the AEMC rejected the use of the term 'well accepted'. Rather, the only reference made by the AEMC to the term was in the following paragraphs from its decision:[529]

> The Tribunal also held that "implicit (or explicit) criticisms of modelling... must be minimised, if not negated, by the requirement that the approach and the model used must be well accepted by those who undertake and use such approaches and models

[527] Ibid.

[528] DBNGP (WA) Transmission 2013, *Response to the Consultation Paper*, www.erawa.gov.au, Att. 3, Table1.

[529] Australian Energy Market Commission 2012, *Rule Determination, National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012*, www.aemc.gov.au, 29 November, p. 48.

for that purpose". As a result "it is almost inherently contradictory then to say that the approach or the model is not likely to produce a reliable output - assuming that the inputs are appropriate – if that approach and that model are well accepted".

The Commission considered that this conclusion presupposes the ability of a single model, by itself, to achieve all that is required by the objective. The Commission is of the view that any relevant evidence on estimation methods, including that from a range of financial models, should be considered to determine whether the overall rate of return objective is satisfied.

23. It is clear from the second paragraph that the Commission took issue with the Tribunal's conclusion that a single model could achieve all that is required by the objective, rather than with the 'acceptance' or otherwise of a particular model. In this context therefore, it remains desirable that a method be well accepted, although it is not necessary that a method be the single most accepted approach.

24. Nevertheless, on review, the Authority considers that well accepted does not link back to the NGL and NGR per se. What is sought here is a criterion that encompasses the idea of performance relating to the task at hand, which is to determine the rate of return commensurate with the efficient financing costs of a benchmark entity with a similar degree of risk in respect of the provision of reference services, over the regulatory years of the access arrangement period. To this end, the Authority considers that the AER's term 'fit for purpose' is better.

25. A method which could be demonstrated to perform best in estimating the cost of debt and the cost of equity – and hence the rate of return over the regulatory years of the access arrangement period – would be most fit for purpose.[530]

26. To the extent that a method performed well in terms of this criterion, it would also be likely to enhance the credibility and acceptability of the decision.

27. The ENA took issue with the use of the term 'fit for purpose' in the AER's list of principles, on the basis that its import is uncertain. The Authority considers that it should now be clear that this term relates to the ability of a method to 'perform well' in terms of estimating the cost of equity and the cost of debt over the regulatory years of the review period.

28. In summary, methods that are desirable are:

- Fit for purpose;
  - able to perform well in estimating the cost of debt and the cost of equity over the regulatory years of the access arrangement period.

Implemented in accordance with best practice

29. The Authority proposed that rate of return methods that 'are robust, transparent, replicable, internally consistent, derived from available, current and credible datasets would help to deliver the allowed rate of return objective. The AER proposed a similar sub-principle in its Issues Paper.[531] The intention was to ensure that the empirical analysis and data supporting the estimation of the rate of return was undertaken in a sound manner.

[530] Refer to NGR 87(4) for reference to the requirement that the allowed rate of return objective be achieved for the regulatory years of the access arrangement period.

[531] Australian Energy Regulator 2012, *Better Regulation: Rate of Return Guidelines: Issues Paper*, December 2012, www.aer.gov.au/node/18859, p. 11.

30. The AER set out this overall criterion as 'implemented in accordance with best practice'. The Authority considers that this criterion captures well the notion of sound estimation approaches, and therefore that it provides a better descriptor. The desirability of best practice methods in achieving the allowed rate of return objective was referred to explicitly by the AEMC (refer paragraph 3 above).

31. In commenting on the AER's principles, ENA accepted the notion of best practice, although it considered that it needed to be conditioned by the term 'consistent with the intention of the rules'.[532] However, the Authority considers that the rules are a given, and as noted above, are explicitly recognised as superior to these criteria. As a result, the Authority does not consider it necessary to restate this in the criteria.

32. ENA also considered that the terms current and relevant be dropped from the principle:[533]

> 'Current' and 'relevant' wording replicates obligations already contained in the Rules. It is appropriate that datasets be reliable.
>
> This amendment is to make it clear that for some parameters the best approach is to use historical databases. In discussing the requirement for regard to be had to prevailing market conditions the AEMC noted: "However, this requirement does not mean that the regulator is restricted from considering historical data in generating its estimate of the required return on equity. Rather, it ensures that current market conditions are fully reflected in such estimates to ensure that allowed rates are sufficient for efficient investment and use."

33. ENA also consider that reference to adjustments and filtering should be as follows:[534]

> That manual adjustments (including filtering) should only be undertaken if there is an economic basis for doing so.

34. The Authority generally accepts these points made by the ENA, but the Authority does not accept that the term 'economic basis' in the last point provides a sole rationale for manual adjustments. The Authority considers that adjustment and filtering of data needs to be undertaken only for sound reasons, for example based on statistical best practice, hence the term should be 'avoids arbitrary filtering or adjustment'.

35. In commenting on the AER's principles, APIA noted that:[535]

> Transparent and replicable decisions are implicitly part of good regulatory practice and the use of sound judgement. APIA is concerned that some stakeholders may consider the use of judgement to be at odds with either characteristic.
>
> Uncertainty needs to be recognised and accounted for. This is a preferable approach to dismissing analysis because of uncertainty,
>
> ...as with uncertainty, high sensitivity should not lead to analysis being dismissed. High sensitivity should be accounted for.

36. The Authority notes that its original sub-principles referred to 'analysis and estimation' methods that are transparent and replicable. The Authority does not

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532 Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.gov.au, Att. 1, p. 11.

533 Ibid.

534 Ibid.

535 The Australian Pipeline Industry Association 2013, Rate of Return Review, www.erawa.gov.au, p. 22.

consider that this term referred more broadly to the overall decision, and thus does not accept APIA's first point set out above. That said, the Authority considers that the AER's broader sub-principle – for approaches which 'promote reasoned, transparent and predictable decision making' – is useful, such that it is included under 'specific regulatory aims' (see below).

37. The Authority proposed that a sub-principle relating to 'deal with uncertainty' would inform the principle 'flexibility to reflect changing market conditions'. This is considered under the next heading below.

38. Finally, with regard to APIA's point relating to high sensitivity, the Authority notes that the sub-criteria involving the term 'sensitive' would not necessarily preclude relevant analysis being considered, unless it did not pass a threshold of statistical soundness. To the extent that the threshold was passed, the degree of sensitivity would then bear on the judgment relating to the degree of relevance of that information.

39. DBP stated in its submission to the Authority:[536]

> ...as "*estimation methods that are internally consistent*" is already a requirement of rule 87(5)(b) it is unnecessary to include as a subordinate 'criteria'.
>
> Criteria which require "*lead to outcomes from quantitative modelling that are sufficiently robust*" fails to recognise that the rule does not prescribe a mechanical process and will require the regulator to apply its judgment at a number of qualitative steps in the process. It is clear that the AEMC was not envisaging a mechanical approach to distilling information from a number of methods when it said –
>
> > "*In many circumstances it could be the case that the likelihood of achieving the NEO or the NGO may be increased by examining a range of methods and data and making judgements aided by, for example, the location and/or clustering and/or statistical precision of estimates. That is, formulaic rules such as giving particular methods a fixed weighting may not be the best way to assess the information*"[8].

40. With regard to internal consistency, the Authority notes that NGR 87(5)(b) states that regard must be had to the 'desirability of using an approach that leads to consistent application of any estimates or financial parameters that are relevant to the estimates of, and that are common to, the return on equity and the return on debt...'. The Authority accepts that this rule effectively encompasses the criteria of internal consistency, and thus that it does not need to be repeated.

41. The Authority does not consider that robust outcomes from quantitative modelling necessarily prescribe some sort of mechanical interpretation. Best practice statistical approaches will help to deliver robust estimates. To the degree that estimates are not robust or statistically sound, then the regulator should take that performance into account in terms of making a judgment as to the effectiveness of that particular method. On this basis, the Authority does not accept DBP's point.

42. In summary, methods that are desirable are:

- Implemented in accordance with best practice;
  - supported by robust, transparent and replicable analysis that is derived from available, credible datasets;

[536] DBNGP (WA) Transmission 2013, *Response to the Consultation Paper*, www.erawa.gov.au, Att. 3, Table1.

- based on quantitative modelling that is sufficiently robust as to not be unduly sensitive to small changes in the inputs data;
- based on quantitative modelling which avoids arbitrary filtering or adjustment of data, which does not have a sound rationale.

Have the capability to reflect changing market conditions and new information

43. The Authority proposed that rate or return methods that 'have the flexibility to reflect changing market conditions and new information as appropriate' would help to deliver the requirements of the NGL and the NGR. The AER proposed that methods should 'have regard to prevailing market conditions'.[537] The intent of this criterion was to recognise that estimation methods, data and other evidence are more likely to be relevant if they are responsive to changing market conditions.

44. DBP noted in its submission to the Authority that this was a reasonable aim, but questioned whether this criterion was in conflict with NGR 87 generally:[538]

> In DBP's view flexibility and the ability to deal with changing market conditions are reasonable aims. However, including such a criteria creates uncertainty in how they may operate with rule 87 as (1) the AEMC's has clearly designed the rule to allow the regulator the flexibility to address changing market conditions and therefore unnecessary to include as a criteria, and (2) rule 87(7) already includes the requirement that in estimating the return on equity under subrule 87(6), regard must be had to the prevailing conditions in the market for equity funds.

45. In this case, the Authority considered that while the NGR refer to the need to have regard to prevailing market conditions under 87(7), this does not capture what is meant by this criterion. What is intended here is that relevant estimation methods have the capability to capture effectively relevant changes in prevailing market conditions or changes that have occurred over historic periods. For example, a sufficiently capable estimation method would be based on timely, available updates to data as to allow the specific method to perform well in meeting the requirements of the NGL and the NGR. Such capability could assist a method to meet the requirement that the return on equity reflect prevailing conditions in the market, or could assist another method to meet the requirement that the return on debt reflect either the return on debt at the time or shortly before the time of the decision, or the average return on debt that would have been required over an historic period. The key point here is, that if the method was able to capture these changes in a timely way, then it could, in the case of the return on equity, diverge from the prevailing conditions in the market for equity funds (refer NGR 87(7)) or, in the case of the return on debt, lead to a lack of minimisation of 'any difference between the return on debt and the return on debt of a benchmark efficient entity' (NGR 87(11(a)).

46. APIA also questioned the AER's explicit reference to prevailing market conditions. However, that requirement is clearly set out in the NGR, and therefore does not need to be repeated in the principles.

47. In summary, methods that are desirable are:

537 Australian Energy Regulator 2012, *Better Regulation: Rate of Return Guidelines: Issues Paper*, December 2012, www.aer.gov.au/node/18859, p. 11.

538 DBNGP (WA) Transmission 2013, *Response to the Consultation Paper*, www.erawa.gov.au, Att. 3, Table1.

- capable of reflecting changes in market conditions and able to incorporate new information as it becomes available.

Are supportive of specific regulatory aims

48. The Authority proposed that it would be desirable if rate of return methods 'lead to consistent regulatory decisions across industries, service providers and time'. Similarly, the AER proposed that methods be 'supportive of broader regulatory aims' and be 'consistently applied across industries, service providers, regulators and time'.[539] The intent of this principle was to recognise that the NGL and the NGR have a range of specific aims, some of which are explicit, and some of which are implicit, which reflect the principles of incentive regulation.

49. The desirability of achieving the specific aims of incentive regulation may be linked back to the efficiency requirements of the NGL and NGR. For example, the Revenue and Pricing Principles (**RPP**) refer explicitly to the need to provide effective incentives to promote economic efficiency (see 0 for more detail):[540]

> (3) A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides. The economic efficiency that should be promoted includes— (a) efficient investment in, or in connection with, a pipeline with which the service provider provides reference services; and (b) the efficient provision of pipeline services; and (c) the efficient use of the pipeline.

50. Accordingly, the Authority considers that this sub-heading should change to state the criterion as being that desirable methods 'are supportive of specific regulatory aims' under the NGL and the NGR. These are intended to refer back to the explicit requirements of the NGL and NGR – as captured in the NGO, the RPP, the rate of return objective, as well as the other requirements of the NGR – as well as to the associated, implicit, outcomes that are consistent with the broad incentive regulation approach and good regulatory practice.

51. It is implicit, for example, that the incentives provided in the exercise of regulatory discretion under the NGR should account for the conditions in the broader economy, faced by other industries, whether regulated or otherwise. Inconsistent incentives could lead to distortions between industries, which would diminish the achievement of economic efficiency. Equally, incentives should avoid creating inter-temporal distortions.

52. The Authority also considers it implicit that the specific aims of the NGL and the NGR are to achieve:

    - rates of return that are consistent with the outcomes of competitive markets, as these are efficient;
    - a net present value of returns is sufficient to cover a service providers' efficient expenditures (the 'NPV=0' condition);
    - simple over complex approaches where appropriate;
    - reasoned, predictable and transparent decisions;

[539] Australian Energy Regulator 2012, *Better Regulation: Rate of Return Guidelines: Issues Paper*, December 2012, www.aer.gov.au/node/18859, p. 11.

[540] Western Australian Government Gazette 2009, *National Gas Access (WA) Act 2009*, www.slp.wa.gov.au, p. 76.

- credible and acceptable decisions.

53. With regard to this criterion (as set out by the AER in its Issues Paper), APIA stated:[541]

> The principles articulated in 5(a to c) are valid aims but should be considered sub-ordinate to other principles. They are not a prime requirement of the law.
>
> - 5(a) Although APIA would not like to see the approach applied to the rate of return shift dramatically from one guideline to the next, APIA sees no requirement in rule 87 to apply methodologies consistently across industries, service providers, regulators and time. In fact, as is outlined in the Brattle Report, while stability and robustness of models are desirable features of models, they must also be able to adjust to changes in economic conditions39. Arguably, the energy sector has its own specific regulator because there does not need to be a level of consistency between the energy industry and other industries. APIA considers that the rule now affords the regulator the flexibility to respond to prevailing conditions in the market. Additionally, methodologies must recognise that differences, not just similarities, apply across industries, service providers, regulators and time.
>
> - 5(b) Methodologies do not need to be comprehensible and accessible to all. To try and achieve this would fail to recognise the complexity of the task. Methodologies should be understood and explained well by regulators and businesses.
>
> - 5(c) APIA does not agree that rule 87 require that simple models be afforded preference over complex models.

54. In response to these points made by APIA, the Authority:

    - considers that all the criteria for the exercise of regulatory discretion are subordinate to the NGL and NGR, hence this should not be a cause to reject these criteria;
    - as noted above, considers that the ability to reflect changing market conditions is a desirable feature, however consider this to be a separate issue to the desirability of regulatory consistency in the application of incentive regulation;
    - accepts that methods need not be comprehensible and accessible by all, but considers it desirable for this to be achieved as far as is possible; and
    - considers that simple models that perform as well as complex models should be preferred, all other things equal.

55. The ENA considers that transparency in the regulator's decision making is important, and suggested that a criterion in this set should relate to this.[542] The Authority considers that the ENA's view is reasonable. However, the Authority considers that this feature is captured in a succinct way along the lines of principle 4(a) set out in the AER's Issues Paper; that the methods promote reasoned, predictable and transparent decision making.

56. The ENA also was concerned that this criteria 'was ambiguous and could be interpreted as a suggestion that regulatory powers might be exercised for

[541] The Australian Pipeline Industry Association 2013, Rate of Return Review, www.erawa.gov.au, p. 22.

[542] Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.gov.au, Att. 1, p. 12.

extraneous purposes', and that therefore this criteria should be excluded.[543] However, as set out above, the Authority considers that the desirability of achieving specific regulatory aims is tied explicitly to the efficiency requirements of the NGL and the NGR, as well as to the generally desirable characteristics for regulation of transparency, simplicity and accessibility.

57. The Authority also notes the ENA's suggestion for the need to account for the effect on incentives to finance efficiently.[544] This element belongs squarely within the intent of this principle, and has therefore been included.

58. DBP had similar views to the ENA with regard to this criteria:

> It is unclear what is meant by the use of the term 'consistent'. DBP would have significant concern if the use of consistent meant that the regulator envisages a 'one size fits all' process applied at each determination and failed to address the allowed rate of return objective.
>
> It is also unclear what the Authority intends as a 'common to approach regulation' does the Authority intend to apply a common approach across all entities regulated by the Authority including gas, electricity and rail despite operating under significantly different regimes? Or does the Authority suggest that commonalities should exist between the Authority and AER?
>
> DBP fails to see the requirement in either the NGO, RPP the allowed rate of return objective or Rule 87 that would require a common approach to regulation, rather the rule promotes a flexible approach to the determination of rate of return ensuring that the allowed rate of return objective is met in each determination for each service provider.

59. In response, the Authority refers to the rationale for this criteria set out above, which is to be mindful of the specific aims of the NGL and the NGR, particular relating to incentives for the promotion of economic efficiency. The Authority also reiterates that these criteria point to desirable outcomes for the exercise of our regulatory discretion within the boundaries of the NGR, not to outcomes which rigidly lead to a 'one size fits all approach'.

60. In summary, the Authority considers methodologies that are desirable are:

- supportive of specific regulatory aims; and thereby:
  - recognise the desirability of consistent approaches to regulation across industry, so as to promote economic efficiency;
  - seek to achieve rates of return that would be consistent with the outcomes of efficient, competitive markets;
  - ensure that the net present value of returns is sufficient to cover a service providers' efficient expenditures (the 'NPV=0' condition);
  - provide incentives to finance efficiently;
  - promote simple over complex approaches where appropriate;
  - promote reasoned, predictable and transparent decision making;
  - enhance the credibility and acceptability of a decision.

543 Ibid.

544 Energy Networks Association 2013, *Authority Consultation Paper – Rate of Return Guidelines*, www.erawa.gov.au, Att. 1, p. 11.

Appendix 4 Evaluating approaches for estimating the cost of debt

1. When considering approaches to the cost of debt, the framework set out in Appendix 3 implies that we evaluate any proposed approach within the three key dimensions:
   - efficiency – does the proposed approach lead to efficient financing costs; in particular, is it:
     - a good predictor for the actual cost of debt in the regulatory years;
     - an approach which retains incentives for the regulated firm to out-perform the estimated cost of debt;
   - reasonable opportunity – does the proposed approach result in a cost of debt that could be achieved in the market place by a firm that met all the characteristics of the benchmark; and
   - transactions costs – does the proposed approach minimise costs for both the regulator and the regulated firm with regard to the cost of debt?

Alternative approaches for estimating the cost of debt

The Authority's current approach

2. The current 'on-the-day' approach used by the Authority is derived as the sum of:
   - the 5-year risk-free rate, averaged over 20 days just prior to the commencement of the regulatory period; and
   - an estimate of the debt risk premium based on the average of a sample of bonds from firms with similar characteristics to the benchmark.

Alternative approaches

3. Alternative approaches to estimating the cost of debt may be based on a 'portfolio approach', either:[545]
   - the trailing average cost of debt – a long term average of historic outcomes on the overall cost of debt; or
   - the hybrid approach – a base rate derived consistent with the on-the-day approach, plus a long term average of the debt risk premium.
4. A further consideration relates to whether to adopt a single estimate once every five years, at the regulatory reset, or to update the cost of debt estimate annually.

Prediction performance

5. In general, the best 'ex ante' predictor of the cost of debt in a future period is the on-the-day estimate made just prior to the future period. Analysis by the Authority supporting this contention is provided at Appendix 6 :

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545 For more details on these alternative approaches, see SFG Consulting 2012, *Rule change proposals relating to the debt component of the regulated rate of return: Report for AEMC*, www.aemc.gov.au.

- The best predictor for the average cost of debt over the *whole of the access arrangement period* is the on-the-day estimate that is made just prior to the commencement of the access arrangement.
- A better predictor of the future cost of debt may be developed by shortening the prediction period, utilising an on-the-day estimate that is updated just prior to *each annual regulatory year*.

6. Under both a portfolio approach and an on-the-day approach, movements in the market return on debt are reflected in the allowed return on debt. This may be either during the regulatory control period, if annual updating is used, or between periods no annual updating are used.

7. By incorporating market changes during the regulatory control period, the annual updating approach improves the performance of *any* predictor for the actual cost of debt. However, to the extent that the on-the-day approach is a better predictor, then again, if updated annually, it would provide the best predictor.

Economic efficiency considerations

8. Economic efficiency may be considered in terms of three components:
   - Productive efficiency is achieved when firms in the economy produce any given level of output at lowest input cost. Such output may include investment in capital goods, as well as production of goods and services from the existing capital stock. The following outcomes will contribute to the achievement of productive efficiency:
     - The regulated firm funds its investments utilising the lowest input cost of debt, which reflects the prevailing interest rates and efficient financing costs.[546]
     - As a corollary, the regulated firm delivers its investments in the way that results in the highest net present value, using a hurdle rate that incorporates the prevailing cost of funds at the time the investment decision was made.
   - Allocative efficiency is achieved when the economy produces only those goods and services which are most valued by society. This occurs at the point where the marginal cost of producing a good or service just equals the willingness to pay for that good or service, which will be reflected in marginal revenue.[547]
     - The choice between investment and consumption in the economy needs to be based on the relative value of that investment to society as a whole. This requires that alternative investments throughout the economy, including by the regulated firm, are based on a hurdle rate that incorporates the prevailing cost of funds.[548]

[546] All of the approaches to estimating the cost of debt will retain incentives for the regulated firm to reduce its cost of debt below the regulatory allowance. However, any shortening the period between updates of the cost of debt may reduce, but are unlikely to remove, the incentives to outperform the regulatory allowance.

[547] Users of the regulated firm's services - both upstream and downstream – make production decisions that are based on efficient prices for the regulated service. At any particular point in time, the capital used for producing the regulated firm's output is 'sunk', and therefore does not contribute to (variable) marginal costs. Use of a regulated firm's service therefore should not depend on the cost of debt.

[548] To ensure optimal levels of investment, correct variable (marginal) cost output pricing is required, as it will reveal the efficient level of demand, and the point at which the network is becoming constrained. Together,

- Dynamic efficiency is achieved when firms make those investments which maximise the returns to the firm and society as a whole over time.
    - Here the cost of capital used by regulated firms – when deciding to invest in additional infrastructure – needs to be updated as market conditions change. The firm's decision should be based on the cost of capital expected to prevail over the life of the investment, and which incorporates the prevailing cost of funds.

9. As it is a better predictor, the on-the-day approach will outperform the trailing average approach with regard to efficiency considerations. Its relative performance against each of these elements is considered further in what follows, starting with dynamic efficiency.

Dynamic efficiency

10. Dynamic efficiency will be enhanced when firms make the 'right' investments that maximise returns over the longer term. The right investments will maximise the net present value over their life, based on a discount rate that reflects the opportunity cost of funds over that life. The prevailing cost of funds is a key component in that discount rate, and hence in ensuring that the right investment decisions are made.

11. As the on-the-day approach has been demonstrated to be a better ex ante predictor than the trailing average approach (see 42), it performs better with regard to this efficiency consideration. This is because the gap between a firm's actual debt finance cost for a new investment and the prevailing debt finance cost is minimised. It is therefore more dynamically efficient.

Allocative efficiency

12. A divergence between actual debt costs and the allowed regulatory return on debt – where the latter is established at the start of the regulatory period ('ex ante') – would likely result in sub-optimal investment decisions. A service provider would be incentivised to over-invest when the prevailing cost of new debt is lower than the regulated allowance, and to under-spend when the opposite is true. This would occur irrespective of whether the ex ante regulated allowance was derived from an 'on-the-day' or portfolio approach.

13. However, as the on-the-day approach has been demonstrated to be a better ex ante predictor than the trailing average approach (see 42), it performs better with regard to this efficiency consideration. This is because the gap between a firm's actual debt finance cost for a new investment and the prevailing debt finance cost is minimised. It is therefore more allocatively efficient.

Productive efficiency

14. Generally, firms adopt a staggered debt portfolio as an efficient means to manage re-financing risk and the associated liquidity risk. Prudent management of re-financing risk lowers the cost of debt.

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the efficient level of demand, combined with the total long run marginal cost of meeting that demand will signal the optimal level of investment to expand output. Here, the cost of debt is included in the total long run marginal cost, and is therefore a consideration in the investment decision

15. However, adopting a more staggered debt portfolio may increase mismatch timing risk. Mismatch timing risk derives from having revenue based on an assumption of the cost of debt that differs from the cost of debt that the firm actually incurs. Increased mismatch timing risk may lead to a higher cost of debt, as lenders seek to account for the overall increased risk. As a consequence, there will be an optimal portfolio, which balances the increased mismatch timing risk with the reduced re-financing risk.

Re-financing risk

16. For the benchmark firm, the current regulatory approach estimates the debt risk premium by estimating the average spread to the risk free rate from a sample of observations of firms with the same credit rating as the benchmark. The resulting average credit spread reflects the average debt risk premium of the sample.

17. The prime driver of credit spreads over the base interest rate, all other things being equal, is the expected value of loss.[549] The expected value of loss is the product of the expected probability of default, and the magnitude of the resulting potential loss. The credit spread for every entity will be different, as in addition to the broader macro and industry risk factors, there will be risk factors that are specific to the entity itself.[550]

18. Given this, the estimated debt risk premium will reflect the 'average' management of the re-financing risk by entities. That is to say, the observed credit spread will reflect the cost of debt associated with the (sample average, efficient) minimisation of the default risk. The corollary is that the estimate includes a risk margin for the expected 'average' value of default for the sample, which is the average amount of residual re-financing risk. It is efficient to trade off some re-financing risk against a reduced cost of debt. To completely eliminate it would be inefficient.

19. It follows that the resulting observed cost of debt is 'around' that of an efficient finance structure. An entity that has implemented an efficient financing structure, which minimises the costs associated with default risk, given the size of its borrowing requirement, is likely to have an equal or lower credit spread than the estimated average credit spread, all other things being equal. If a regulated firm was not managing re-financing risk at least as efficiently as the average, then it would likely have a higher credit spread.

20. Given that we are seeking a 'reasonable' estimate of the cost of debt over the access arrangement period, the sample of observations gives a 'reasonable' credit spread, which includes a margin for the efficient level of residual default risk. On this basis, the sample estimate will give a debt risk premium, which when added to the risk free rate, provides for a cost of debt which the efficient firm will have a reasonable opportunity to achieve.

Mismatch timing risk

21. The major issue for regulated firms would therefore appear to be the mismatch timing risk. A major criticism of the on-the-day approach is that firms are unable to match the resulting estimate used by the regulator to set the return on debt.

[549] The base rate may be either the Commonwealth Government Securities bond, or the swap rate.

[550] As noted by the Brattle Group, credit risk includes systematic and non-systematic risks (see Australian Pipeline Industry Association 2012, *Rate of Return Review*, www.erawa.com.au, Schedule 2, p. 68).

The inability to match existing staggered debt costs to the regulated on-the-day rate arises because there are barriers in financial markets that preclude complete hedging. These barriers in large part arise due to a lack of adequate debt markets in Australia, of reasonable depth and liquidity.

22. Even where an actual difference in a regulated firm's actual cost of debt arises – as compared to the regulated cost of debt – the firm's net present value of its debt may still equal zero over the long run (NPV=0), provided that the average term of the firm's debt matches the term of the regulatory estimate (five years), all other things being equal (see Appendix 2 for a summary of evidence). However, with imperfect hedging, this outcome is less assured. Nevertheless, even with imperfect hedging, the over-statement of the cost of debt will be matched by under-statement of the cost of debt over the long term. It follows then that NPV=0 is likely to be maintained over the longer term.

23. Mismatch timing risk has a cost, in that it leads to increased volatility for cash flows to equity.[551]

24. This volatility would result in a higher β, all other things being equal, so would still be compensated for the regulated firm. To the extent that this volatility was reduced, such as by moving to some kind of trailing average approach, then historic observations of the β would need to be adjusted down, to account for the reduction of this mismatch timing risk.

25. However, as noted at paragraph 38 above, it is desirable that the efficient benchmark cost of debt reflects the actual opportunity costs, and not be hypothetical. To the extent that the benchmark firm cannot match the on-the-day estimate, due to financial market barriers, then there is a concern.

Ability to reduce mismatch timing risk through hedging

26. The Authority engaged Chairmont Consulting to evaluate the degree to which a regulated firm may hedge its portfolio of debt to match the current on-the-day regulated rate, and the costs of doing so.[552]

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[551] SFG Consulting 2012, *Rule change proposals relating to the debt component of the regulated rate of return*, www.aemc.gov.au, p. 22.

In this context, the Authority notes that DBP consider that it is not 'the volatility of cash flows that matter for beta, but the covariance of cash flows with the market' (see DBNGP (WA) Transmission Pty Ltd 2013, *Submission to the ERA Benchmark Cost of Debt Secretariat Working Paper*, www.erawa.com.au, p. 18).

The Authority agrees with DBP's view that it is the covariance of cash flows with the market that matters for the estimate of beta.

However, it is accepted that the beta measures the covariance of the return on equity of the regulated firm with the variance of the market. As gearing increases, so too does the equity beta (through the levering of the asset beta), reflecting an increased exposure of equity to systematic risk. This occurs because increased debt will take an increased (invariant) proportion of the cash flows, all other things equal (including variance relating to the cost of debt), leaving a smaller but more variable proportion for equity.

It is now assumed that gearing is held constant. In the extremis, to the extent that the trailing average passed through the 'embedded' cost of the firm's debt, then the systematic variance of the cash flows relating to the cost of debt is significantly reduced. In this case, the Authority is of the view that mismatch pricing risk is reduced. As such, the resulting variation in cash flows to equity will be reduced, for any given level of leverage, as equity no longer has to absorb the unders and overs due to mismatch pricing on debt. The covariance of the returns on equity to the market will be reduced. It is argued that the beta will be lower in this case. For a further exposition of this, see SFG Consulting 2012, *Rule change proposals relating to the debt component of the regulated rate of return: Report for AEMC*, www.aemc.gov.au, p. 42.

[552] Chairmont Consulting 2013, *Comparative Hedging Analysis*, www.erawa.com.au.

27. Chairmont concluded that hedging the on-the-day regulated rate is not possible:

- efficient firms stagger their debt issuance, typically issuing debt 'opportunistically' in a range of markets, as a means to manage re-financing and liquidity risk;
- this leads to mismatch timing risk, also known as re-pricing risk, which is associated with the constrained cost of debt set by the regulator through the on-the-day approach;
- regulated firms can hedge the on-the-day regulated base risk free rate for even very large amounts of debt through interest rate swaps, at low cost;
- however, there are no effective tools for hedging the debt risk premium in Australia – Credit Default Swaps provide one avenue but this market is narrow, reasonably illiquid, and there are no Credit Default Swaps available that are linked to the debt risk premium of the companies regulated by the Authority;
- therefore, a basis risk variation between the actual and benchmark cost of debt remains.

28. Chairmont's estimates of the basis point differential between a typical efficient portfolio and the on-the-day cost under plausible scenarios is:

- up to around 150 bps where no hedging is undertaken; and
- around 50 bps if hedging of the base swap rate is undertaken.

Is some residual level of basis risk efficient?

29. Chairmont note that a typical 'competitive' firm will seek to cost effectively remove any mismatch timing risk.[553] The base rate component could be hedged by purchasing exchange traded futures on Commonwealth Government Securities, or by undertaking interest rate swaps.[554] However, the competitive firm's debt risk premium cannot be hedged consistently, except by a few large firms of sufficient size for which there is a liquid corporate debt market. As a result, the competitive firm will inevitably face some mismatch timing risk on the debt risk premium component of its past debt issuances. Chairmont note:[555]

> Most companies regardless of the industry will face either some degree of Mismatch Interest Rate Risk or some risk of an interest rate increase on the expense side which has no offsetting counterpart on the revenue side.

30. The result is that some residual basis mismatch timing risk related to the debt risk premium for a regulated firm could be consistent with that faced by an unregulated competitive firm operating in the economy:[556]

> It is noted that non-regulated companies in other industries are also likely to face some form of interest rate risk, because they do not have revenue items which equally offset changes in their debt funding costs. Some businesses are likely to face greater interest rate risk than regulated utilities and some are likely to face less. The special case of regulated energy entities arises because the revenue impact of interest rates is fixed

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[553] This is the standard approach where the cost of finance is not a core business or profit centre. See Chairmont Consulting 2013, *Comparative Hedging Analysis*, www.erawa.com.au, p. 9.

[554] Ibid, p. 4.

[555] Ibid, p. 9.

[556] Chairmont Consulting 2013, *Comparative Hedging Analysis*, www.erawa.com.au, p. 15.

each five years for that amount of time, whereas a non-regulated industry will typically face changing interest rate impacts continually across time.

31. Both the regulated firm and the competitive firm may readily manage the base rate timing risk through swaps.[557] To the extent that residual basis risk is similar, the regulator need not be concerned.

32. On the other hand, it may be observed that if the regulator set the cost of debt through a portfolio approach, then the regulated firm could have no residual mismatch timing risk, where it issued debt in equal tranches consistent with the periods of the trailing average. As the mismatch timing risk relates largely to the debt risk premium, then this would be the same irrespective of whether a pure trailing average or a hybrid portfolio was adopted.

33. Removing this mismatch timing risk from the regulated firm could artificially lower the cost of debt, all other things equal, given that lenders consider all risks when setting the debt risk premium. This artificial lowering for the regulated firm, as compared to the market firm, would result in a distortion in financing costs between firms in the economy. This provides a further reason, in addition to the efficiency considerations, as to why the trailing average portfolio approach is less efficient than the on-the-day approach.

An optimum approach to setting the regulated cost of debt?

34. The 'once every five years' setting of the regulatory cost of debt under the current approach is an artificial constraint on regulated firms, which is not faced by competitive market players. This may increase the extent of the mismatch timing risk for the regulated firm, as compared to the competitive market firm. This difference occurs because the regulated debt risk premium is fixed every five years, but the competitive market debt risk premium may vary continuously.

35. A solution to the artificial constraint imposed by the once every five years setting of the regulated cost of debt could be to update the estimate of the cost of debt annually. Updating the on-the-day estimate annually would bring the cost of debt faced by the regulated firm much closer to the prevailing cost of debt faced by the competitive market firm. The resulting mismatch timing risk would also therefore be similar, and thus reasonable. Annual updating of the on-the-day estimate would also have the benefit of improving the performance of the ex ante predictor of the cost of debt, with associated dynamic efficiency benefits (as set out above).

36. However, there would be potential costs in terms of increased transactions costs, and also in a reduction in incentives to 'beat' the regulated rate.

37. Transactions costs could be minimised by only 'trueing up' any differences – between the once every five years cost of debt, made at the start of the regulatory period, and subsequent differences to the annual updated cost of debt – at the next regulatory reset. Such an approach would virtually remove transactions costs, while retaining strong incentives for efficient investment.

[557] Chairmont Consulting also note that hedging through swaps also hedges a portion of the debt risk premium, consistent with the spread between the risk free rate and the base swaps rate (see Chairmont Consulting 2013, *Comparative Hedging Analysis*, www.erawa.com.au, p. 14).

Appendix 5 Descriptions of companies in the sample

Ticker	Industry Sector	Company Description (as at April 2013)
ENV AU Equity	Utilities	Envestra Limited operates natural gas distribution networks and transmission pipelines in South Australia, Queensland and the Northern Territory. The Company's networks distribute gas to households and businesses in Adelaide, Brisbane (north of Brisbane River), Alice Springs and various regional centers in South Australia and Queensland.
APA AU Equity	Energy	APA Group is a natural gas infrastructure company. The Company owns and or operates gas transmission and distribution assets whose pipelines span every state and territory in mainland Australia. APA Group also holds minority interests in energy infrastructure enterprises.
DUE AU Equity	Utilities	DUET Group invests in energy utility assets located in Australia and New Zealand. The Group's investment assets include gas pipelines and electricity distribution networks.
HDF AU Equity	Financial	Hastings Diversified Utilities Fund invests in utility infrastructure assets such as gas transmission and distribution assets, electricity generation, transmission and distribution assets, hydro and wind power generation assets and regulated and unregulated assets.
SPN AU Equity	Utilities	SP Ausnet owns and operates electricity transmission and electricity and gas distribution assets in Victoria, Australia.
SKI AU Equity	Utilities	Spark Infrastructure Group invests in utility infrastructure assets in Australia.

Source: Bloomberg

Appendix 6 The Diebold Mariano Test

Updated analysis on the forecasting efficiency of an averaging period using the Diebold-Mariano test

1. The Authority has recently extended its analysis presenting the empirical evidence of the predictive power of various averaging periods – using the Diebold-Mariano test – that was set out in its recent Western Power decision.

2. In this updated analysis, two scenarios are considered:

   i) with annual updates where the risk free rate is updated each year for all of the 5 years over the regulatory period; and

   ii) without annual updates where the risk free rate is fixed for the whole 5 year regulatory period.

3. Doing so is in response to the proposal that the averaging period of a risk-free rate of 5 years, with annual updating, should be used to estimate a risk-free rate for the subsequent regulatory control period of 5 years. The key conclusions can be summarised as below.

4. First, when no annual update is used:
   - an averaging period of 20 trading days is superior to averaging periods of 5 and 10 years to predict the risk free rate for the regulatory control period over the subsequent 5 years; and
   - an averaging period of 60 trading days is still a superior forecast to averaging periods of 5 and 10 years for the risk free rate over the subsequent 5 years.

5. Second, when the annual update is used:
   - an averaging period of 20 trading days is again, superior to averaging periods of 5 and 10 years for the regulatory control period; and
   - an averaging period of 60 trading days is still a superior forecast to averaging periods of 5 and 10 years for the subsequent regulatory control period.

6. Third, the only instance where a longer term forecasting period is superior in the analysis is when an averaging period of 5 years with annual update is tested against an averaging period of 20 (or 60) trading days with no annual update. Only then is the predictive power of an averaging period of 5 years superior to that of a shorter averaging period. The Authority notes however, that this is not a "like-with-like" comparison.

7. Fourth, with a regulatory control period of 5 years, an averaging period of 60 trading days would still ensure that forecasting efficiency (or its predictive power) is statistically comparable to the more efficient short term forecasts. There is no statistical difference between an averaging period of 20 days and an averaging period of 60 days; that is, both averaging periods have the same forecasting power of the risk free rate for the subsequent regulatory control period of 5 years.

Submissions

8. DBNGP Transmission (**DBP**) proposed that the Authority had made statistical errors when making use of the Diebold –Mariano (**DM**) to compare the forecasting efficiency of 20 day averages of the risk free rate of return vis-à-vis other averaging periods. This was on the basis that the forecast error series resulting from each of the averaging periods were not covariance-stationary when one is subtracted from the other to create the loss differential required when implementing the DM-test.

9. DBP used daily data on a 10 year Commonwealth Government Security from January 1995 to May 2013 to construct the error terms.

Considerations of the Authority

10. An explanation of some key concepts from basic econometric texts is given below in order to highlight where DBP's analysis requires augmentation so that more robust conclusions can be drawn from it.

Diebold- Mariano Test

11. The DM test was outlined in the Western Power third Access Arrangement.

12. It must be noted that the ERA now uses an absolute value loss function shown below as opposed to a squared value, as it has no reason to believe the forecast errors are quadratic.[558] All other details on the procedure are the same otherwise.

$$L(\varepsilon^{i}_{t+h|t}) = |[\varepsilon^{i}_{t+h|t}]|, \; i = 1,2 \qquad (28)$$

Stationarity

13. In order to better understand the issue a brief explanation of stationarity follows.

14. A series of observations on a variable X_t through time is 'covariance-stationary' (also referred to as weakly stationary or just stationary) if it has a finite mean and variance. That is, its mean and covariance are not dependent on the point in time they are observed.

15. The covariance however can be a function of the distance between two observations, X_t and X_{t-s} where the covariance is constant for all t given s, but can vary with a change in s, that is the distance between two points in time. It should be noted that when s is equal to zero the covariance is equal to variance.

16. The concept of stationarity is important in time series because data from the past is used to quantify relationships to inform future outcomes. If a series is not stationary this implies the future can differ fundamentally from the past. In the context of data if the mean and covariance is dependent on time the distribution of a time series variable can change over time.

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[558] Enders. W, 2004, 'Applied Econometric Time Series', Second Edition, John Wiley & Sons, Inc. p. 86.

17. This point is important in relation to the DM tests, because the behaviour of the forecast errors in the series are based on the past observations and if not stationary, may not say much, if anything about the future.

Integrated Series

18. There are cases in which a non-stationary series X_t becomes stationary in its difference. That is the series $\Delta X_t = X_t - X_{t-1}$ becomes stationary. A typical example is stock prices which often have a tendency to 'jump' and 'meander' in an erratic manner, while the return which is calculated from the differences in the prices is typically more constrained in its movements and tend to test as stationary.

19. A series that is stationary in levels (not differenced) is integrated of order zero; I(0). A series that becomes stationary after it is differenced once (first difference) is known as being integrated of order one, that is I(1). If the series is stationary after being differenced twice it is integrated of order two and generalising if it is stationary after differencing d times it is integrated of order d; I(d).

$$X_t \sim I(d) \tag{29}$$

20. When considering two different time series the following property applies:

$$\text{If } X_t \sim I(d) \text{ and } Y_t \sim I(d), \text{ then } Z_t = (aX_t + bY_t) \sim I(d^*)$$

21. Where the case d* < d can arise if the series are co-integrated, that is the linear combination of a non-stationary series can become stationary, in a sense by 'offsetting' each others' movements. The rule also implies that the linear combination of a stationary series is itself stationary.

Power of Stationarity tests

22. It has long been recognised that tests for stationarity based on the hypothesis that the series contains a unit root (as explained in the Third Western Power Access Arrangement) are plagued by issues of lower power when faced with short samples.[559] Power refers to the probability of correctly rejecting the null hypothesis in the case that it is false. In the context of time series stationarity this concerns correctly rejecting the finding of a unit root; that is, a non-stationary series. More specifically the power of such tests increase with the time span of a series for any given sample size. For example, 30 observations spanning 4 years have more power than 30 observations spanning 1 year.

Empirical Tests

23. Augmented Dickey Fuller (ADF) tests were carried out using Bloomberg data on the 10 year Commonwealth Government Bond Index. The data spans December 1969 to February 2013. After calculating the appropriate averages for the forecasts and realised value over the regulatory period and trimming each sample down to match the shortest (10 year series) a sample of 7456 daily observations was realised spanning July 1979 to February 2008.

[559] Frankel, J & Rose, A (1995), *A Panel Project on Purchasing Power Parity: Mean Reversion within and Between Countries*, NBER Working Paper Series, Working Paper No.5, p.1.

24. The results from the tests on the forecast error series both with and without annual update are presented below.

Table 35 Averaging Period Forecast Errors

Error Series	test statistic	1 per cent	5 per cent	10 per cent	Outcome	Sample
No Annual Update						
10 Year	-2.108	-2.58	-1.95	-1.62	Stationary at 5 percent	7456
5 Year	-1.980	-2.58	-1.95	-1.62	Stationary at 5 percent	7456
60 Day	-3.534	-2.58	-1.95	-1.62	Stationary at 1 percent	7456
20 Day	-3.572	-2.58	-1.95	-1.62	Stationary at 1 percent	7456
Annual Update						
10 Year	-1.934	-2.58	-1.95	-1.62	Stationary at 10 percent	7456
5 Year	-2.030	-2.58	-1.95	-1.62	Stationary at 5 percent	7456
60 Day	-5.293	-2.58	-1.95	-1.62	Stationary at 1 percent	7456
20 Day	-7.291	-2.58	-1.95	-1.62	Stationary at 1 percent	7456

Source: Economic Regulation Authority's analysis

25. All series test to be stationary at either the 1; 5 or 10 per cent level critical value. This tends to indicate that the forecast errors in the past can inform the behaviour of forecast errors in future as there is no evidence that the mean and covariance change through time.

26. The DM test requires a loss differential to be calculated:

$$\bar{d} = \frac{1}{T}\sum_{i=1}^{T}\left[L(\varepsilon_{t+h|t}^{1}) - L(\varepsilon_{t+h|t}^{2})\right] \quad (30)$$

27. This is the difference between the absolute values of the 20 day averaging period forecast errors and absolute value of other averaging period forecast errors.

28. At this point it is worth recalling the preceding discussion on integrated series. A linear combination of stationary series will itself be stationary. The loss differential calculated on absolute values will therefore be stationary.

29. This is observed empirically in the results below, both for the series with and without annual update.

Table 36 Loss Differential Series ADF Test: July 1979 - 2013

Error Series	Test statistic	1 per cent	5 per cent	10 per cent	Outcome [Stationary at]	Sample
No Annual Update						
10 Year	-3.092	-2.58	-1.95	-1.62	1 percent	7456
5 Year	-3.406	-2.58	-1.95	-1.62	1 percent	7456
60 Day	-16.289	-2.58	-1.95	-1.62	1 percent	7456
Annual Update						
10 Year	-1.768	-2.58	-1.95	-1.62	10 percent	7456
5 Year	-2.310	-2.58	-1.95	-1.62	5 percent	7456
60 Day	-17.064	-2.58	-1.95	-1.62	1 percent	7456

Source: *Economic Regulation Authority's analysis*

30. All loss differential series test as stationary at either 1, 5 or 10 per cent critical values.

31. The question then remains as to why DBP's results differ.

32. They noted that their sample spanned January 1995 to May 2013. Given that the 10 year trailing average consumes 10 years worth of observations from the starting date and that all series need to be of the same length in the DM test, DBP would have been left with a sample effectively starting from January 2005.

33. In addition, as DBP note 5 years worth of observations dating back from 2013 are also consumed to create the realised 5 year regulatory period average. In light of the above discussion on the power of stationarity tests, DBP's sample would have significantly less power than the sample used in the above analysis.

34. The data set in the above analysis was truncated to go back only as far as January 2005. This produced 817 observations. The above results are reproduced below based on this sample.

Table 37 Loss Differential ADF Tests: 2005 – 2013

Error Series	Test statistic	1 per cent	5 per cent	10 per cent	Outcome [Stationary at]	Sample
No Annual Update						
10 Year	-4.996	-3.96	-3.41	-3.12	1 percent	817
5 Year	-4.419	-3.96	-3.41	-3.12	1 percent	817
60 Day	-6.765	-2.58	-1.95	-1.62	1 percent	817
Annual Update						
10 Year	-3.136	-3.96	-3.41	-3.12	10 percent	817
5 Year	-3.335	-3.96	-3.41	-3.12	5 percent	817
60 Day	-4.428	-3.96	-3.41	-3.12	1 percent	817

Source: *Economic Regulation Authority's analysis*

35. The plots for the loss differential series based on the 10- and 5-year trailing average without annual update indicated a strong upward trend, likely a result of the rapidly decline in interest rates post 2008 that will cause the 10- and 5-year average period forecast errors to rapidly diverge from the 20 day forecast errors. As a result the 10 and 5 year ADF tests included a trend. The 20-60 day averaging period loss exhibited no drift or trend.

36. The plots for the loss differential for all series without annual update exhibited a downward trend. Accordingly, the ADF test for these included a trend.

37. Again, all tests indicate the loss differentials are stationary at either 1; 5 or 10 per cent, despite the low power of the test meaning this outcome would only if the result is robust.

Peer review

38. The Authority engaged Data Analysis Australia (**DAA**) to review its test data and conclusions from its application of the DM test.[560]

39. DAA concluded:

- the forecast errors had been correctly calculated;
- the tests for stationarity of the loss differentials were carried out in an appropriate manner;
- it is appropriate to use the forecast package and R to carry out the DM test; and
- that the *dm.test* function was correctly applied.

40. DAA further concluded that in its view that on the basis of the DM test data:

- the 20 day averaging outperforms 5 year averaging and 10 year averaging; and
- there is little evidence to favour 20 day averaging over 1 year averaging and there is some evidence that for the period since 1993 the 1 year averaging is superior; and
- the optimal amount of time included in the average is likely to be between 20 days and 1 year.

Conclusions

41. The ERA's loss differentials used in the DM tests are found to be stationary even when using samples based on a short time span such as those used by DBP. The difference between the ERA's results and DBP's are not explained by the use of a short time span, although DBP should note that the short time spans used in their tests are pre-disposed to not rejecting the hypothesis of a unit root (suggesting non-stationary series) given their low power.

42. Additionally, common unit root tests for stationarity such as the ADF are very sensitive to the specification of the test; that is whether a trend or intercept is included. Again, DBP should ensure the tests are correctly specified.

[560] Data Analysis Australia 2013, *Review of Risk Free Rate Calculation*, www.erawa.com.au, p. i.

Appendix 7 Forecasting Efficiency of an Averaging Period

Issue

1. The Queensland Treasury Corporation (QTC) has for some time proposed the use of a 'trailing average approach' to estimating the cost of debt in cost of capital determinations for regulated entities. Specifically, they advocate the use of a 10-year trailing average, updated annually at the beginning of each regulatory year in the five-year regulatory control period.

2. The Authority currently advocates the use of the 'current' cost of debt as the most efficient forecast of the average cost of debt over the forward looking 5 year regulatory period. The rationale is based on the efficient market hypothesis which postulates that where rates follow a random walk, today's rate is the most 'efficient' forecaster of tomorrow's rate.

3. In order to determine whether this method is efficient the Diebold-Mariano tests of forecasting efficiency were used to test the predictive power of the 20-day average, the current averaging period, versus the 10-year trailing average forecast, proposed by QTC.

Background

4. The Diebold-Mariano test previously outlined in the Authority's averaging period analysis has been identified as an effective and objective test of forecasting efficiency.

Current Findings

Data

5. Bloomberg's data on the 10-year Commonwealth Government Security indices were used in the analysis as this provided the longest time series. The 20-day, 60-day and 10-year averaging periods were compared. For each of these averaging periods, two additional series were created: (1) the annually updated series at the beginning of the year; and (2) the fixed series without annual updates.

Annually Updated Series

6. The annually updated series updated the risk-free rate estimate at the beginning of each year over a 5-year period to reflect the assumption that 20 per cent of an entire debt portfolio refinancing each year. This update was based on either the 20 days, or the 60 days or the 10 years prior to the relevant year of the regulatory control period. The average was then calculated for the 5 year period and compared this average to the observed average to derive an error forecast series which could be tested against a competing forecast's error series.

Fixed Series

7. The fixed series only updated the forecast at the beginning of a 5-year period based on either the 20-days period, or the 60-days period or the 10-years period prior to a relevant regulatory control period. This average was then compared to

the observed average of a historical risk-free rate for the 5-year period to derive an error series to be tested against the others.

8. The data covers the period from July 1979 to February 2008. Five years of data are lost from 2013 retrospectively, as the 5-year observed averages of a risk-free rate require the 5 years of data ahead. The data set comprised 7,460 observations.

Results

9. Two different scenarios were tested:

- Both the 20- (or the 60-) days period and the 10-year fixed series were tested against each other, to be named as *Scenario 1*.
- Both the 20- (or the 60-) days period and the 10-year annually updated series were tested against each other, to be named as *Scenario 2*.

Table 38 Diebold-Mariano Test Results for the 20-Day Averaging Versus the 10-Year Averaging Period

	Scenario 1	Scenario 2
Absolute Loss Function	-2.90	**-3.11**
Outcome:	Reject	**Reject**
20 Day Forecast is:	Superior	**Superior**

Source: Economic Regulation Authority's analysis

10. Results which the absolute values are greater than 1.96 are statistically significant with 95 per cent confidence. Negative values indicate that the twenty day average is the superior forecast, where as positive results indicate the opposite. The results in Table 38 indicate that, in all three scenarios, the 20-day forecast is superior compared with the 10-year averaging period.

Table 39 Diebold-Mariano Test Results for the 60-Day Averaging Versus the 10-Year Averaging Period

	Scenario 1	Scenario 2
Absolute Loss Function	-2.92	-3.16
Outcome:	Reject	Reject
60 Day Forecast is:	Superior	Superior

Source: Economic Regulation Authority's analysis

11. Table 39 indicates that, in all three scenarios, the 60-day forecast is superior over the 10-year averaging period.

12. The same tests as above were conducted using a 5 year trailing average series in place of 10 years. The results are shown in Table 40 below.

Table 40 Diebold-Mariano Test Results for the 20-Day Averaging Versus the 5-Year Averaging Period

	Scenario 1	Scenario 2
Absolute Loss Function	-2.57	-2.46
Outcome:	Reject	Reject
20 Day Forecast is:	Superior	Superior

Source: Economic Regulation Authority's analysis

13. The findings are that the 20-day averaging period is superior to the 5-year trailing average in the two scenarios.

Table 41 Diebold-Mariano Test Results for the 60-Day Averaging Versus the 5-Year Averaging Period

	Scenario 1	Scenario 2
Absolute Loss Function	-2.66	-2.48
Outcome:	Reject	Reject
60 Day Forecast is:	Superior	Superior

Source: Economic Regulation Authority's analysis

14. Table 41 above indicates that the 60-day averaging period is superior to the 5-year trailing average in the first two scenarios.

Concluding remarks

15. This Appendix has presented the empirical evidence in terms of the predictive power of various averaging periods using Diebold Mariano test. Both annual updates and no annual updates are considered. The key conclusions can be summarised as below.

- *First*, when no annual update is considered, an averaging period of the 20 trading days is superior to the averaging periods of 5 years and of 10 years for the regulatory control period of the subsequent 5 years.
- *Second*, when no annual update is considered, an averaging period of the 60 trading days is still superior to the averaging periods of 5 years and of 10 years for the regulatory control period of the subsequent 5 years. It is noted that the analysis only considered the averaging period of 50 days; 60 days and so on.
- *Third*, when the annual update is considered, an averaging period of 20 trading days is superior to the averaging periods of 5 years and of 10 years for the regulatory control period of the subsequent 5 years.
- *Fourth*, when the annual update is considered, an averaging period of 60 trading days is superior to the averaging periods of 5 years and of 10 years for the regulatory control period of the subsequent 5 years.
- *Fifth*, with the regulatory control period of 5 years, the averaging period of 60 trading days is the longest possible period to ensure that its forecasting efficiency (or its predictive power) is still statistically better than the

averaging periods of either 5 years or 10 years in both cases: (i) annual updates; and (ii) no annual updates. It is noted that, with the regulatory control period of 5 years, in terms of forecasting efficiency, there is no statistical difference between the averaging period of 20 days and the averaging period of 60 days (i.e. both averaging periods have the same forecasting power of the risk free rate for the subsequent regulatory control period of 5 years).

16. In conclusion, the Authority are of the view that the current practice adopting an averaging period of 20 trading days is still the best proxy for the risk-free rate of the next 5 years.

Appendix 8 Credit ratings of Gas & Electricity businesses, excluding Government, 2008-2012

Industry	Company	2008	2009	2010	2011	2012
Gas	Alinta Network Holdings Pty Ltd/WA Network Holdings Pty Ltd/ATCO Gas Australia LP.	BBB	BBB-	BBB-	BBB-	BBB
	DBNGP Finance Co Pty Ltd	BBB	BBB-	BBB-	BBB-	**N/A**
	DBNGP Trust	BBB-	BBB-	BBB-	BBB-	BBB-
	Energy Partnership (Gas) Pty Ltd	BBB-	BBB-	BBB-	BBB-	BBB-
	Envestra Ltd	BBB-	BBB-	BBB-	BBB-	BBB-
	Envestra Victoria Pty Ltd	BBB-	BBB-	BBB-	**N/A**	**N/A**
	Gas Net Australia (Operations) Pty Ltd/APT pipelines Ltd	BBB	BBB	BBB	BBB	BBB
Gas & Electricity	SP AusNet Group	A-	A-	A-	A-	A-
	SPI Australia Holdings (Partnership) LP	A-	A-	**N/A**	**N/A**	**N/A**
	SPI Electricity & Gas Australia Holdings Pty Ltd	A-	A-	A-	**N/A**	**N/A**
	DUET Group	BBB-	BBB-	BBB-	BBB-	BBB-
	Alinta LGA Ltd/Jemena/SPI (Australia) Assets Pty Ltd.	A-	A-	A-	A-	A-
Electricity	The CitiPower Trust	A-	A-	A-	A-	A-
	ElectraNet Pty Ltd	BBB+	BBB+	BBB	BBB	BBB
	ETSA Utilities Finance Pty Ltd	A-	A-	A-	A-	A-
	Powercor Australia LLC	A-	A-	A-	A-	A-
	SPI Electricity Pty Ltd	A-	A-	**N/A**	**N/A**	**N/A**
	SPI PowerNet Pty Ltd	A-	A-	**N/A**	**N/A**	**N/A**
	United Energy Distribution Holdings Pty Ltd	BBB	BBB	BBB	BBB	BBB
	United Energy Distribution Pty Ltd	BBB	BBB	BBB	BBB	**N/A**
	Median Credit Rating	**BBB+**	**BBB+**	**BBB**	**BBB**	**BBB**

Source: Economic Regulation Authorities analysis.

Appendix 9 Various approaches currently available to determining a benchmark credit rating

1. Lally (2006)[561] applied Ordinary Least Squares (OLS) analysis in order to determine the appropriate credit rating for the benchmark efficient entity. This approach involves examining the relationship between the credit rating (the dependant variable) and variables relative to the credit rating, such as financial cash flows and qualitative variables. Lally assigned numbers to credit ratings in order to perform the regression. The benefit of this approach is that it allows a credit rating to be calculated given a set of financial data. For example, the benchmark efficient assumption of 60 per cent gearing could be an input into this model. However, the drawback of this approach is that it assumes that credit ratings are *equidistant.* That is, the difference in credit worthiness between ratings is the same. In addition, credit ratings are by definition discrete variables, whereas OLS is based on the assumption of continuous variables. The AER attributes little weight to this approach due to these criticisms.[562]

2. Logit analysis has been suggested as a more appropriate method for estimating the credit rating of a benchmark efficient firm than the OLS analysis.[563] Logit analysis uses dependent variables that can only take on discrete values, whose magnitude is not significant.[564] The discrete variables do however have a specific ordering. Logit analysis assigns a probability of the dependent variable occurring, based on values of the independent variables. In the context of credit rating analysis, logit analysis assigns probabilities to each possible credit rating, reflecting the likelihood a firm has the given credit rating. Logit analysis estimates these probabilities via the values of a company's financial data. The credit rating of a benchmark efficient firm would be assigned by choosing the credit rating that has the highest probability.[565] This method has the advantage of being directly applicable to estimating the benchmark firm credit rating, as credit ratings are by definition discrete variables that have a specific ordering. This method however requires a large sample of observations in order to be reliable. Given the lack of observations for regulated entities, the AER considered this approach to be unreliable.[566] They noted however they would revisit this approach in the future if more data became available.

3. The simple average value of credit ratings involves assigning numbers to credit ratings of comparable businesses, and then taking the simple average. The value obtained in this approach is then taken as the benchmark efficient credit rating. The AER notes that this approach implies that the distance between credit ratings are uniformly distributed, implying the difference in creditworthiness between each rating is the same.[567] In addition, the presence of a single outlier observation can bias the outcome. The AER therefore considers that the average

561 Lally, *The Appropriate Credit Rating for Australian Electricity Transmission Businesses,* Paper in support of AER Submission, March 2006.

562 Australian Energy Regulator, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters,* May 2009, p. 357.

563 Ibid.

564 Cramer, J.S (2003), *Logit Models from Economics and Other Fields,* Cambridge University Press, p. 1.

565 Australian Energy Regulator, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters,* May 2009, p. 357.

566 Ibid.

567 Australian Energy Regulator, *Explanatory Statement Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters,* December 2008.

credit rating value should only be used as a cross check for the benchmark efficient credit rating.

4. The median value approach involves taking the median credit rating of a sample of comparator businesses, and using this value as the credit rating for the benchmark efficient credit rating. This approach is relatively robust to the presence of outliers in the comparator business sample relative to the average sample approach. This approach does not require any strong assumptions required for the average value of the credit rating as above. This approach was used by the Authority in its recent Western Power access decision. [568]

5. The best comparator approach was suggested by ACG in 2006[569] in response to the large number of variables that affect credit rating and the lack of credit rated Australian firms. This method involves observing the most relevant financial indicators for a sample of firms that have been subject to recent regulatory decisions.[570] These ratios are then projected into the future regulatory period, and compared to the same financial indicators of relevant listed Australian firms. The credit rating for the benchmark efficient firm is then estimated from the credit rating of the most comparable listed Australian firms. ACG used ElectraNet, GasNet, United Energy, Envestra and DUET for the comparable listed Australian firms, but placed less weight on United Energy due to their broadband service. Using this method, ACG concluded that ElectraNet is the best listed comparator, and chose a credit rating of BBB+ as the representative credit rating of the benchmark efficient entity. The AER noted that while no method is perfect, the best comparator approach uses businesses that have a higher level of gearing then that assumed for the benchmark efficient entity, which biases the estimated credit rating. In addition, the AER suggested that this is a simplistic approach which focuses only on a limited number of financial indicators, when in reality the credit rating process is highly complex.[571]

[568] Economic Regulation Authority, *Final decision on proposed revisions to the access arrangement for Western Power*, 2012.

[569] ACG, *Credit rating for a benchmark electricity transmission business,* Report to Electricity Transmission Network Owners Forum, May 2006.

[570] Australian Energy Regulator, *Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters,* May 2009, p. 358.

[571] Ibid.

Appendix 10 Credit ratings of Gas & Electricity businesses, excluding Government and Parent, 2008-2012

Industry	Company	2008	2009	2010	2011	2012
Gas	Alinta Network Holdings Pty Ltd/WA Network Holdings Pty Ltd/ATCO Gas Australia LP.	BBB	BBB-	BBB-	BBB-	BBB
	DBNGP Finance Co Pty Ltd	BBB	BBB-	BBB-	BBB-	**N/A**
	DBNGP Trust	BBB-	BBB-	BBB-	BBB-	BBB-
	Energy Partnership (Gas) Pty Ltd	BBB-	BBB-	BBB-	BBB-	BBB-
	Envestra Ltd	BBB-	BBB-	BBB-	BBB-	BBB-
	Envestra Victoria Pty Ltd	BBB-	BBB-	BBB-	**N/A**	**N/A**
Gas & Electricity	SP AusNet Group	A-	A-	A-	A-	A-
	SPI Australia Holdings (Partnership) LP	A-	A-	**N/A**	**N/A**	**N/A**
	SPI Electricity & Gas Australia Holdings Pty Ltd	A-	A-	A-	**N/A**	**N/A**
	Alinta LGA Ltd/Jemena/SPI (Australia) Assets Pty Ltd.	A-	A-	A-	A-	A-
Electricity	The CitiPower Trust	A-	A-	A-	A-	A-
	ElectraNet Pty Ltd	BBB+	BBB+	BBB	BBB	BBB
	ETSA Utilities Finance Pty Ltd	A-	A-	A-	A-	A-
	Powercor Australia LLC	A-	A-	A-	A-	A-
	SPI Electricity Pty Ltd	A-	A-	**N/A**	**N/A**	**N/A**
	SPI PowerNet Pty Ltd	A-	A-	**N/A**	**N/A**	**N/A**
	United Energy Distribution Holdings Pty Ltd	BBB	BBB	BBB	BBB	BBB
	United Energy Distribution Pty Ltd	BBB	BBB	BBB	BBB	**N/A**
	Median Credit Rating	**BBB+**	**BBB+**	**BBB**	**BBB**	**BBB**

Source: Economic Regulation Authorities analysis.

Appendix 11 Models for estimating the return on equity

1. The standard regulatory implementation of the Capital Asset Pricing Model (CAPM) is labelled the Sharpe-Lintner CAPM, after two of the original authors.

2. Other asset pricing models in the CAPM family build on the standard Sharpe-Lintner CAPM, including:

   - the Black and Empirical CAPM;
   - the Consumption CAPM; and
   - the Inter-temporal CAPM.

3. There is also a large range of other models which seek to estimate the return on equity, including:

   - Arbitrage Pricing Theory family of models;
   - the Fama-French Three-Factor Model and its extensions;
   - the Dividend Discount Model family (both single-stage and multi-stage);
   - the Residual Income Model;
   - Market Risk Premium approaches; and
   - the Build-up Method.

4. In addition, there are approaches that are not based on modelling per se, but rather on available data for a range of comparators or analysts' reports. These include:

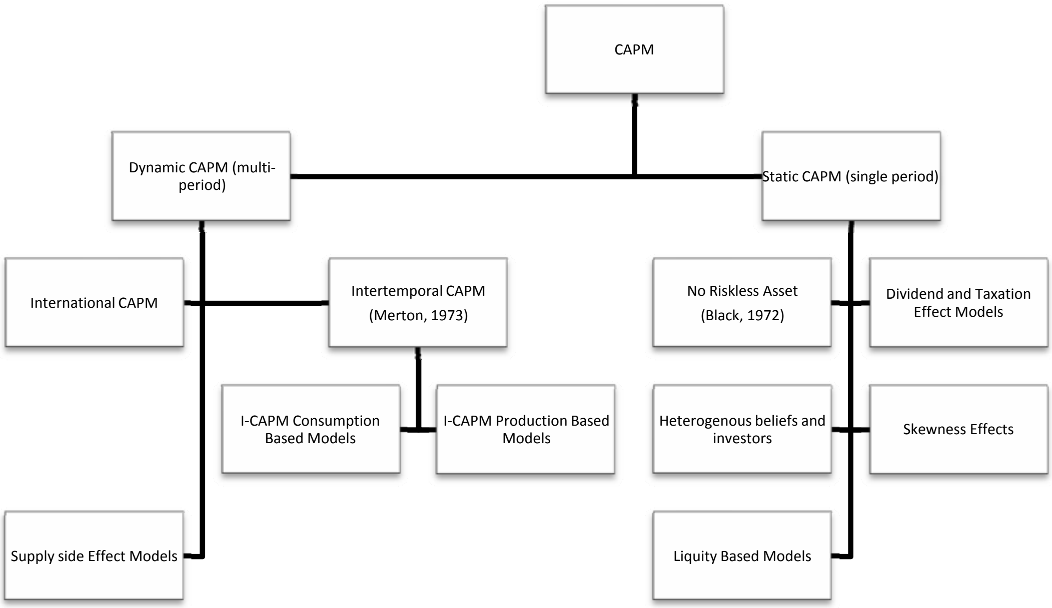
   - estimated market returns on comparable businesses;
   - price to book ratios;
   - analyst reports.

5. Each of these approaches is briefly summarised in what follows.

The Capital Asset Pricing Models

6. The CAPM can be traced back to the first version developed in 1956, which became known as the Sharpe-Lintner CAPM. The CAPM 'family' of models for the return on equity may be divided between static single period and dynamic multi-period models (Figure 23).

Figure 23 Summary of the CAPM literature



Source: McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC, DRAFT Report to the AER*, www.aer.gov.au, p. 26.

Sharpe-Lintner CAPM

7. The Sharp-Lintner CAPM explains the expected return, $E(r_t)$, on any financial asset i in terms of the rate of return on a risk-free asset, r_f, and a premium for risk, $\left(E(r_M)-r_f\right)\times\beta_i$, where $E(r_M)$ is the expected rate of return on a market portfolio of assets, the term $\left(E(r_M)-r_f\right)$ represents the market risk premium (MRP). β_i is the equity beta of asset i and is defined as $\beta_i = \text{cov}(r_i, r_M)/\text{var}(r_M)$:

$$r_e = r_f + \left(E(r_M)-r_f\right)\times\beta_i \tag{31}$$

8. The equity beta provides the key estimate of the risk associated with the underlying asset, as it measures the sensitivity of the returns for that asset to the systematic variation in the returns of the market as a whole. All other non-systematic risks associated with the underlying asset are assumed to be diversified away through the efficient market portfolio.

9. The Sharpe-Linter CAPM is based on the following assumptions:[572]

   - Investors are risk averse and, when choosing among portfolios, only care about the mean and variance of their investment return. As a consequence, investors choose 'mean-variance efficient' portfolios.

[572] Fama E.F and French K.R (2004), 'The Capital Asset Pricing Model: Theory and Evidence' *Journal of Economic Perspectives* – Volume 18 Summer 2004.

- Investors agree on the joint probability distribution of asset returns, and this is the correct distribution of asset returns.
- Investors face no taxes or transaction costs.
- Borrowing and lending occur freely at the same risk free rate, which is the same for all investors and does not depend on the amount borrowed or lent.

The Black and the Empirical CAPM

10. The Black CAPM was developed from the Sharp-Lintner CAPM, but does not assume the existence of a single risk free rate asset and does not assume the availability of unrestricted borrowing and lending.

11. In Black's derivation, the return on a portfolio of assets for which the return is uncorrelated with the return on the market portfolio – known as the zero-beta portfolio – acts as the equivalent of the risk free return. The Black CAPM specification assumes that the expected return of a zero beta portfolio, $E[r_z]$ falls in the range between the lending and borrowing rate of return, $\mathrm{r}_l < E[r_z] < \mathrm{r}_b$.

12. The Black CAPM can be stated as follows:

$$E[r_j] - E[r_z] = \beta_j[E(r_m) - E(r_z)], \qquad \mathrm{r}_l < E[r_z] < \mathrm{r}_b \tag{32}$$

where

$E[r_z]$ is the expected return of a "zero beta" portfolio, estimated from data on buying and short selling risk-free assets;

$E(r_m)$ is the expected return of the market portfolio;

r_l is the lending rate of return; and

r_b is the borrowing rate of return.

13. Closely aligned to the Black CAPM, models which seek to empirically estimate the return on equity are known as the Empirical CAPM. These models take the general form:

$$E\left[r\right] = rf + \alpha + \beta_j \; x \; \left(MRP - \alpha\right) \tag{33}$$

where

α is a constant which adjusts the standard CAPM risk return line (or Security Market Line).

Inter-temporal CAPM

14. The Sharpe-Lintner and Empirical CAPM models are based on the covariance of the firm's security with the returns on all equities in the market, at any (static) point in time. As such, these models relate the return on the security to general

movements in wealth, which are reflected in the equilibrium value of the market portfolio.

15. Merton suggested that the Sharp-Lintner CAPM and the Black CAPM are subject to theoretical objections because they were derived within the mean-variance framework.[573] Merton then derived a general form of the asset pricing relationship, using a standard model of inter-temporal choice from microeconomic theory. By doing so, Merton also dropped the assumption of a single time period as adopted in both the Sharp-Lintner CAPM and the Black CAPM.[574]

16. Merton's Intertemporal CAPM incorporates intertemporal conditioning variables for the return on the asset, in the form of a range of future state variables that are priced:[575]

> In the I-CAPM, however, investors are also concerned with the opportunities they will have to invest (or consume) the payoff. These opportunities vary with future state variables, which capture expectations about income, consumption and investment opportunities. Equilibrium in this model suggests that investors expected returns will reflect not only market risk, but also compensation for bearing the risk of unfavourable shifts in the investment opportunity set.

17. Formally, Merton's theory of inter-temporal choice presents that:

$$P_t = E_t\left[m_{t+1}; x_{t+1}\right] \quad (34)$$

where

P_t is the equilibrium asset price at time t;

x_{t+1} is the uncertain payoff on the asset at time $t+1$; and

m_{t+1} is the stochastic discount factor which is determined by the ratio of the marginal utility of goods and services consumption tomorrow $\left(MU_{t+1}\right)$ and the marginal utility of goods and services consumption today $\left(MU_t\right)$.

18. McKenzie and Partington describe a simple form of the Inter-temporal CAPM, which builds on the standard form of the single factor CAPM to add a single additional factor that co-varies negatively with the risk free rate:[576]

$$E\left[r_i\right] = rf + \delta_1\left(E\left[r^m\right] - rf\right) + \delta_2\left(E\left[r^n\right] - rf\right) \quad (35)$$

where

r^n is the instantaneous return on an asset displaying perfect negative correlation to r^f;

δ_1 and δ_2 are weights given by:

573 Robert Merton (1973), "An Inter-temporal Capital Asset Pricing Model", *Econometrica,* 4(15), pp. 867-887.

574 DBNGP Revised Access Arrangement Proposal Submission, pp. 15-16.

575 McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 24.

576 McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, provided as part of workshop materials, p. 28.

$$\delta_1 = \frac{\beta_{im} - \beta_{in}\beta_{nm}}{1 - \rho_{nm}^2} \text{ and } \delta_1 = \frac{\beta_{in} - \beta_{im}\beta_{nm}}{1 - \rho_{nm}^2} \text{ ; and}$$

$\beta_{ik} = \frac{Cov(r_i, r^k)}{Var(r^k)}$ where K indexes the factors.

Consumption CAPM

19. By assuming that investors maximise a lifetime utility function and there exists a capital market that allows consumers to smooth consumption over different periods, the return of assets may be linearly related to the growth rate in aggregate consumption.[577] As such, consumers are concerned not just with their wealth, but also 'the risk of changes in reinvestment opportunities over time'.[578]

20. Based on this approach, the Consumption CAPM relates the return on the security to movements in aggregate consumption, through the covariance of the return on the security with that the variance in aggregate consumption. This can be formally expressed as:

$$E[R_{i,t}] = \alpha + \beta_i C_t \quad (36)$$

where

C_t is the growth rate in aggregate consumption per capita at time t.

$E[R_{i,t}]$ is the expected rate of return of asset i in period t.

β_i is the sensitivity of the rate of return of asset i to changes in consumption per capita, $\beta_i = \frac{Cov(R_{i,t}, C_t)}{Var(C_t)}$.

Arbitrage Pricing Theory

21. Arbitrage pricing theory (**APT**) prices assets through a factor model of asset risks. It relies on multiple factors in explaining asset returns, as opposed to only the single systematic risk factor of the Sharpe-Lintner CAPM. The factor parameters measure the stock's covariance with each risk factor at any point in time, similar to the CAPM.[579]

22. Formally, the APT replaces the mean variance structure used to develop the CAPM by assuming that the expected return of a stock is linearly related to a set of n risk factors as follows:[580]

$$E[r_i] = R_f + \sum_{j=1}^{n} b_{i,j} RP_j \quad (37)$$

where

[577] Elton E.J, Gruber M.J, Brown S.J & Goetzmann W.N (20xx), *Modern Portfolio Theory and Investment Analysis*

[578] McKenzie M. and Partington G. 2013, *Risk, Asset Pricing and the WACC*, DRAFT Report to the AER, www.aer.gov.au, p. 22.

[579] APT differs from the CAPM in not having assumptions of investor risk aversion or normality of returns. However, the zero beta CAPM can be derived as a special case of the APT (see Levy, H 2012, *The Capital Asset Pricing Model in the 21st Century*, Cambridge University Press, p. 183).

[580] Pratt, S.P & Grabowski, R.J 2010, *Cost of Capital Applications and Examples, Fourth Edition.* John Wiley & Sons p 352.

$E[r_i]$ is the expected rate of return on stock i;

R_f is the risk free rate;

RP_j is the risk premium associated with risk factor j; and

$b_{i,j}$ is the sensitivity of stock i to risk factor j.

23. Intuitively, this model assumes that investors require compensation for being exposed to a variety of risk factors. It is noted that the model does not specify a theoretical basis for the risk factors. However, most parameterisations of the APT utilise risk factors that are related to the state of the economy, such as the debt risk premium, level of inflation and the change in gross national product.[581]

Fama-French Three-Factor Model

24. The development of the Fama-French Three-factor model (**FFM**) was a response to empirical studies assessing the performance of the CAPM. Fama and French noted that the cross-section of average returns on the US stocks showed little relation to the equity beta β of the Sharpe-Linter CAPM or the consumption based CAPM beta.[582] Fama and French also noted that other financial variables, such as size (as measured by market capitalisation), leverage, Earnings/Price ratio and book-to market equity ratio show considerable power in explaining average returns.

25. With respect to stock returns, Fama and French analysed three common risk factors for stocks that influence their return, including (i) the excess market return, (ii) the size of the firm; and (iii) the book-to-market ratio of the firm. Fama and French designed portfolios that represent each of these risk factors, and use them to explain historical stock returns.

26. The Fama-French Three-Factor Model (**FFM**) identifies three sources of undiversifiable risk that address all three above-mentioned anomalies:

27. The excess return to the market portfolio (the market risk premium, **MRP**);

28. The value or growth risk premium, high minus low (**HML**) – the premium earned by HML book value shares. In this asset pricing model, high-value firms have a high ratio between book value of equity and market value of equity whereas the opposite is true for low-value firms (also known as growth shares); and

29. The size risk premium, small minus big (**SMB**) – the premium earned by SMB shares. Small (big) firms have small (big) total capitalisation (i.e. equity at market value).

30. The return on equity for the firm estimated by the FFM is defined as follows:

$$r_e = r_f + \left(E\left(r_M\right) - r_f\right) \times \beta_m + HML \times h + SMB \times s \tag{38}$$

[581] ibid

[582] Fama E.F and French K.R 1993, 'Common risk factors in the returns on stocks and bonds', *Journal of Financial Economics*.

where:

$E[R_j]$ is the expected return of stock j.

R_f is the risk free rate.

b_j is the covariance sensitivity of stock j to variance in the market portfolio, as per the CAPM.

MRP is a risk premium associated with the risk of aggregate market fluctuations, which represents the systematic risk, as per the CAPM.

h_j is the covariance sensitivity of stock j to changes in the High minus Low portfolio.

HML is a risk premium associated with the differential in returns earned by firms with high and low book-to-market values of equity.

s_j is the sensitivity of stock j to changes in the Small minus Big portfolio

SMB is a risk premium associated with the differential in returns earned by small market capitalisation firms and large capitalisation firms.

31. The FFM states that small firms and firms with high book-to-market ratios require additional returns to compensate investors for these additional risks. Accordingly, large firms and firms with a low book-to-market ratio have less risk and therefore investors require a lower rate of return.

Zero-beta Fama French Model

32. The Zero-beta Fama-French Model is a combination of selected elements from both the Black CAPM and the FFM in which a zero-beta portfolio from Black CAPM is used instead of the risk-free rate of return from Fama-French CAPM.

$$r_e = E\left(r_z\right) + \left(E\left(r_M\right) - r_z\right) \times \beta_m + HML \times h + SMB \times s \qquad (39)$$

Dividend Discount Models

33. Dividend Discount Models (**DDM**) seek to estimate the internal rate of return which equates the present value of the expected stream of future returns with the present value of the underlying asset value. Future returns may include dividends, retained earnings or other cash flows. Share repurchases and capital contributions such as dividend reinvestment plans need to be excluded, and account needs to be taken of implicit tax cash flows, which will depend on the specific taxation treatment.

34. These models are based on an ‘implied’ return on equity, as they are not derived from any theoretical underpinning as to what prices the return. For example, they do not identify the risks which investors bear in exchange for the expected future return.

35. DDM may be based on either a single stage or multi-stage internal rate of return.

- The single stage DDM, or Gordon growth model, calculates the return on equity by treating dividends as a perpetuity. The dividends are assumed to grow at a constant periodical rate and expressed as a proportion of the current share price in order to calculate a dividend yield. This yield is augmented with the growth rate to arrive the estimated return on equity:

$$r_s = \frac{D_0(1+g)}{P} + g \qquad (40)$$

where

r_s is the return on the security;

D_o is the dividend;

g is the expected growth rate in the dividend; and

P is value of the underlying asset.

- The multistage DDM does not assume a constant growth rate and instead forecasts dividends at varying rates of growth for the near term before they eventually reach a terminal growth rate. A price is determined for the equity once the terminal growth rate is reached which is then discounted along with the various dividends in the periods in which they occur using the general present value formula. The discount rate that equates these cash flows to the current share price is the estimated return on equity.

Residual Income Model

36. The Residual Income Model (**RIM**) discounts future streams of residual earnings and adds them to the book-value of equity. The residual earnings reflect future income, net of future expenses. The return on equity is then estimated as the discount rate that equates the sum of the book value of equity plus discounted residual income to the current share price valuation of the assets.

37. The Residual Income Model is an identical valuation framework to the DDM approach, with the difference being whether net cash flow (dividends plus retained earnings) are being used for the valuation, or gross cash flows in terms of expenses and revenues.[583]

38. The RIM, like the multistage DDM, is usually based on analysts' forecasts to determine growth rates in the residual income in the near term, which then attenuate to an assumed long run growth rate.[584]

Market risk premium

39. This approach typically uses the historical spread between returns from entities in the same industry, based on either accounting conventions or stocks, and the return from a given debt instrument to estimate a premium. This estimated risk premium then acts as a margin added to returns observed on the debt instrument.

40. As such, the model represents a simplified version of the CAPM:

$$r_e = r_d + RP \qquad (41)$$

where

583 Lundholm R. and O'Keefe T. 2001, Reconciling value estimates from the discounted cash flow model and the residual income model, *Contempory Account Research*, 18 (2), p. 311 – 335 quoted in SFG 2010, *The required return on equity commensurate with current conditions in the market for funds*, Report for WA Gas Networks, www.erawa.com.au, p. 15.

584 The Australian Pipeline Industry Association 2013, *Rate of Return Review*, www.erawa.gov.au, Schedule 2, p. 31.

r_e = return on equity;

r_d = return a selected debt instrument; and

RP = estimated risk premium.

Build-up Method

41. The cost of equity is a calculated as a sum of the risk free rate, market risk premium, firm size premium, industry premium and premiums for any other factors that capture specific risks:

$$r_e = rf + RP + FS + I + \sum_{i=1}^{n} F_i \quad (42)$$

where

r_e is return on equity;

r_f is Risk-Free Rate;

RP is Market Risk Premium;

FS is Firm Size Premium;

I is Industry Premium; and

$\sum_{i=1}^{n} F_i$ is premiums for other potential factors

Market returns on comparable investments

42. The realized accounting rate of return is calculated for comparable entities. This is done for a sample of companies over a specified time period to average out fluctuations and company specific factors. Risk adjustments are then made to account for differences between the comparable entities and company analysed.

43. The approach provides for a simple check. However, it is noted that the evidence on comparable investments is generally inconclusive regarding the return investors expect and there is no evidence to suggest that these returns are sufficiently comparable to the regulated utilities.

Appendix 12 A Modern Portfolio Theory

1. Modern portfolio theory (MPT) seeks to determine how a rational investor will allocate capital between various securities. By combining stocks in a portfolio, the MPT demonstrates that investors can achieve superior levels of expected return by taking on a given level of risk than that which could be achieved by holding individual stocks. In addition, this MPR theory also assumes that investors can borrow and lend their capital at the risk free rate. In this context, the MPT theory presents that an optimal portfolio exists, to be called the market portfolio, which maximises the expected return per unit of risk. Investors then determine the proportion of capital they allocate between a risk-free asset, which is risk-free, and the optimal market portfolio, which is risky, through their preference for risk.

2. Formally, an investor is presented with a universe of assets that are assumed to be random variables in which to allocate their capital. That is, each assets value in the future is uncertain and only probability statements can be made about the likelihood of their future value or return. Modern portfolio theory determines how a rational investor will allocate their capital in the face of this uncertainty. The uncertainty is quantified by the variance of the probability distribution585, while its expected return is the mean value of the probability distribution. The variance is an estimate of the likely divergence from the expected return of an asset and is therefore seen as a measure of risk. Risk can also be expressed in terms of the standard deviation of expected returns. Note that in this initial stage, every asset is assumed to have some level of risk. Let X_i represent the i^{th} asset, $U=\{X_1, X_2, ...X_n\}$ be the universe of n assets, R_i be the return of the i^{th} asset (assumed to be a random variable), $R_i \sim f_i(x)$ be the assumed probability distribution of returns for the i^{th} asset. The expected return of X_i is thus $E[R_i]$ and it's risk is the variance of return, $Var[R_i]=\sigma_i^2$. Each stock is therefore assumed to have a probability distribution, with the mean of the distribution determining the expected return of the stock and the variance of the probability distribution determining the level of risk. In addition, each stock is assumed to be related to all others via the correlation coefficient between itself and the other stocks in the portfolio. That is, the correlation in returns between assets R_i, R_j is $-1 \le \rho_{i,j} \le 1$. The correlation coefficient measures the degree of the relationship between R_i, R_j. The portfolio choices of an investor can be represented by the proportion of their capital they chose to allocate to each asset in the universe U. Therefore, let w_i be the proportion of capital allocated to asset X_i. It follows that $0 \le w_i \le 1$ and $\sum_{i=1}^{n} w_i = 1$.

[585] *The variance of a continuous random variable, X, with probability density function f(x) is given by* $Var(X)=\sigma^2=\int_{-\infty}^{\infty}(x-E[X])^2 f(x)dx$, *with it's expected return,* $E[X])=\int_{-\infty}^{\infty} x.f(x)dx$.

3. Given the above framework, the expected return and risk of a portfolio of assets derived from universe U for given proportions $w_1, w_2, ..., w_n$ can be calculated. The expected return of a portfolio, $E[R]$, is a weighted average of its component securities, using the proportion of capital invested in the security as follows586:

$$E[R] = \sum_{i=1}^{n} w_i \text{x} E[R_i] \qquad (43)$$

4. Note that the equation above states the portfolios expected return is a function only of the proportions invested in each security and it's corresponding expected return. The variance of the portfolio can be defined as the likely divergence from the expected return of the portfolio, represented in the equation above.

5. The variance of this portfolio, σ_p^2, of assets can be summarised as below:[587]

6. $$\sigma_p^2 = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j \neq i}^{n} w_i w_j \sigma_i \sigma_j \rho_{ij}$$

(44)

7. Here the variance of the portfolio is a function of the variance of component securities and the correlation between component securities. It can be shown that if $\rho_{i,j} \neq 1$ for all securities, investors can reduce their exposure to risk by holding a portfolio of assets. That is, the risk of holding a portfolio of stocks , σ_p^2, is less than the risk of any of the component securities, σ_i.[588] This is diversification; the holding of multiple securities reduces an investor's exposure to risk, as diversification reduces variability in the return of the portfolio as a whole. Diversification reduces risk as a consequence of the fact that different stocks are not perfectly correlated and as a consequence stocks will not move in unison. It can be shown that as the amount of stocks in the portfolio increases, the portfolio approaches the average covariance between component securities.[589] This average covariance cannot be diversified away, as common stocks will always move together in response to common risks. The risk that remains after diversification is known as market risk or systematic risk, and represents risk that is faced by all firms in the economy. Figure 24 demonstrates the impact of diversification on a portfolio of securities:

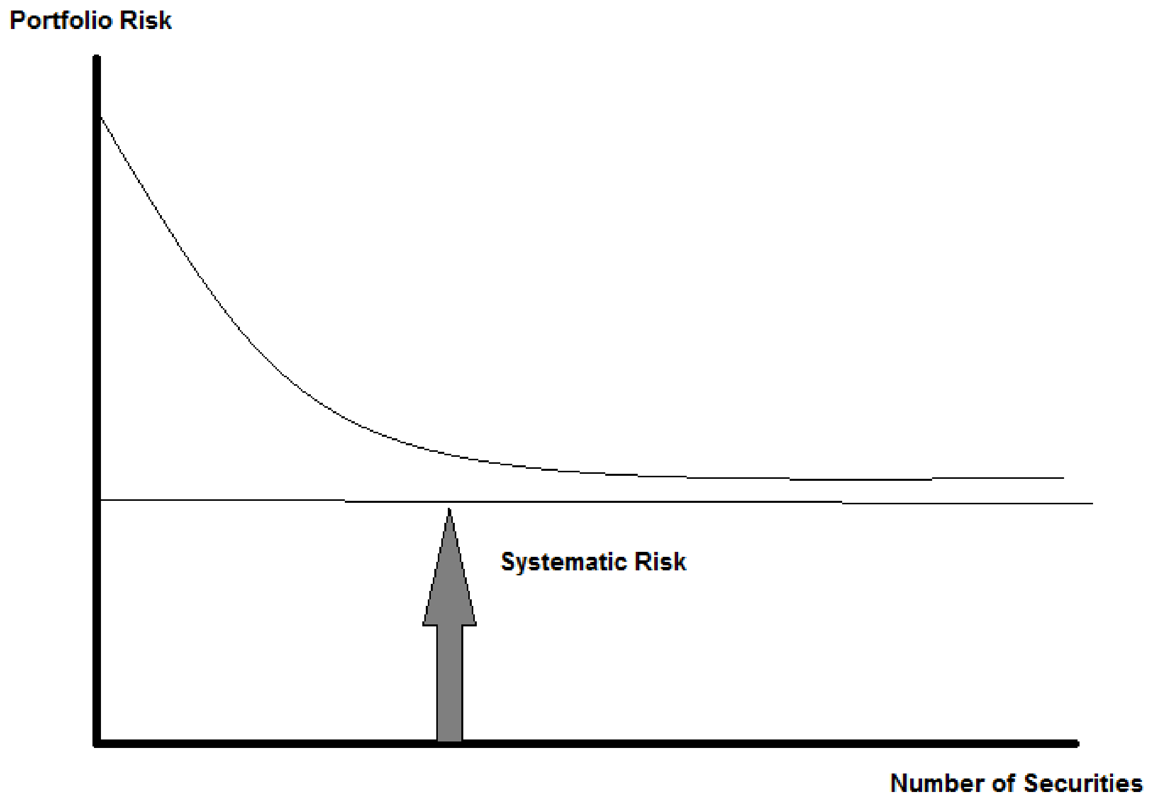
[586] Sharp, W.F (1985), *Investments Third Edition,* Prentice-Hall, New Jearsey, p121

[587] Ibid, p. 129.

[588] Myers. S.C. and Brealey, R.A *Principles of Corporate Finance 7th Edition,* McGraw- Hill , 2003, p. 171.

[589] Ibid, p. 172.

Figure 24 Diversification



8. Therefore, investors can choose their desired level of expected return and risk by altering the proportion of their capital they allocate between securities, $w_1, w_2, ..., w_n$. An investor's preference for risk and return therefore determines how they construct their portfolios.

9. Each investor is assumed to have a utility function with assigns a value to each possible combination of risk and return, with the value of the utility function representing the investor's preference.590 This assumed utility function assigns higher values to combinations of risk and return that have higher expected rates of return for a given level of risk, and higher values to combinations that have the same expected rates of return but lower levels of risk. This implies that investor's are risk averse when determining their capital allocation, preferring a higher expected return and less risk. As a consequence, modern portfolio theory seeks to determine the maximum value of this utility function, with the portfolio that maximises a given investors utility function being the optimal portfolio for the investor. Linter (1965) notes that these indifference curves are complex and non-linear.[591]

10. A "frontier" of possible portfolio expected returns and variances can be developed by varying the choice of portfolio weights $w_1, w_2, ..., w_n$. 592 This frontier shows all possible combinations of risk and return. Given that investors prefer more expected return and less risk, it makes sense to only consider the "efficient

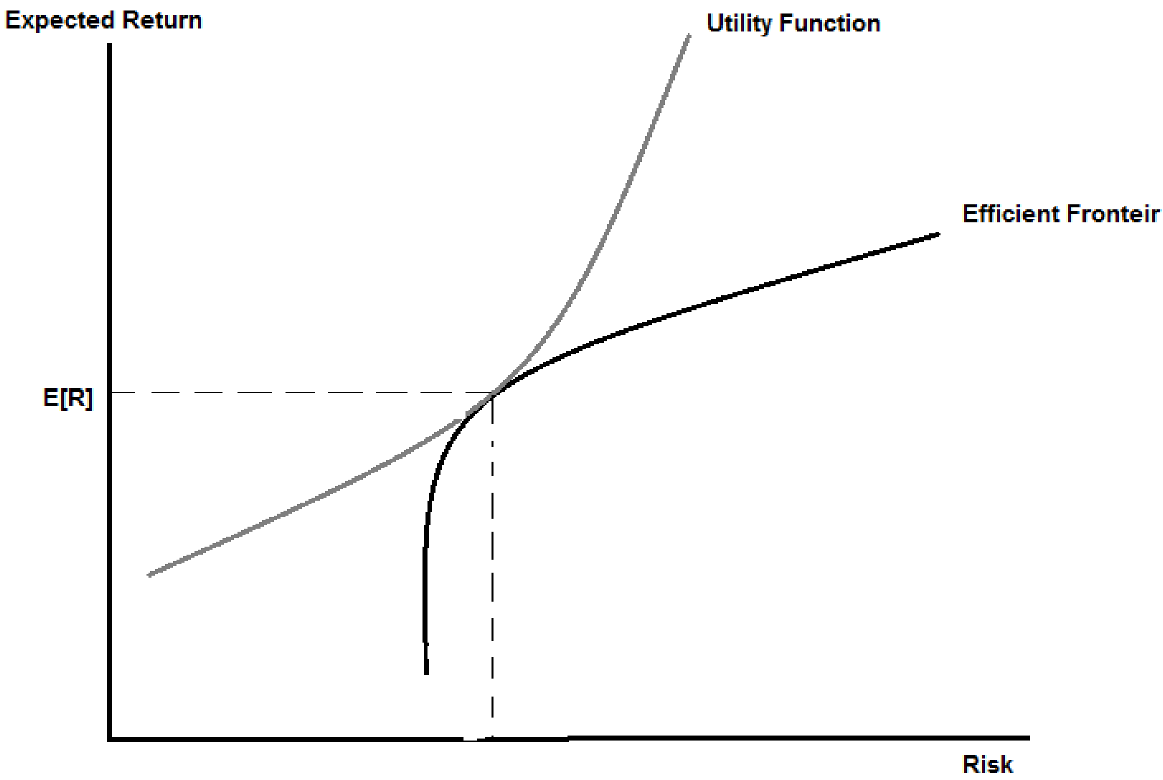
[590] Linter .J, 'The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets', *The Review of Economics and Statistics,* Vol. 47. No.1 (Feb, 1965), pp 13-37.

[591] Ibid.

[592] Markowitz, H. "Portfolio Selection", *The Journal of Finance,* Vol. 7, No.1 (March 1952).

frontier", those combinations with a minimum variance for a given expected return or a maximum expected return for a given variance. An investor will therefore allocate their capital to the point on the efficient frontier that maximises their utility function. This implies that investors seek to maximise their expected return per unit of risk, and choose their level of risk and thus expected return based on their own personal preference for risk. This situation is depicted in Figure 25 below:

Figure 25 Portfolio Selection with No Risk Free Asset



11. This model was developed on the assumption that all assets in the universe have some degree of risk. This model is extended further by allowing for the existence of a risk-free asset. That is, an asset that has zero variance. In this context, capital can be allocated to the risk-free asset such as Commonwealth government securities, together with a portfolio of stocks. If we treat a risky portfolio on the efficient frontier as a single asset, with expected return $E[R_r]$ and variance σ_r^2, and a risk free asset with expected return r_f and variance 0 and allocate capital between both assets, w_r [593] and w_{rf} [594] we have:

$$E[R_p] = w_r E[R_r] + w_{rf} r_f = w_r E[R_r] + (1 - w_r) r_f = r_f + w_r (E[R_r] - r_f) \quad (45)$$

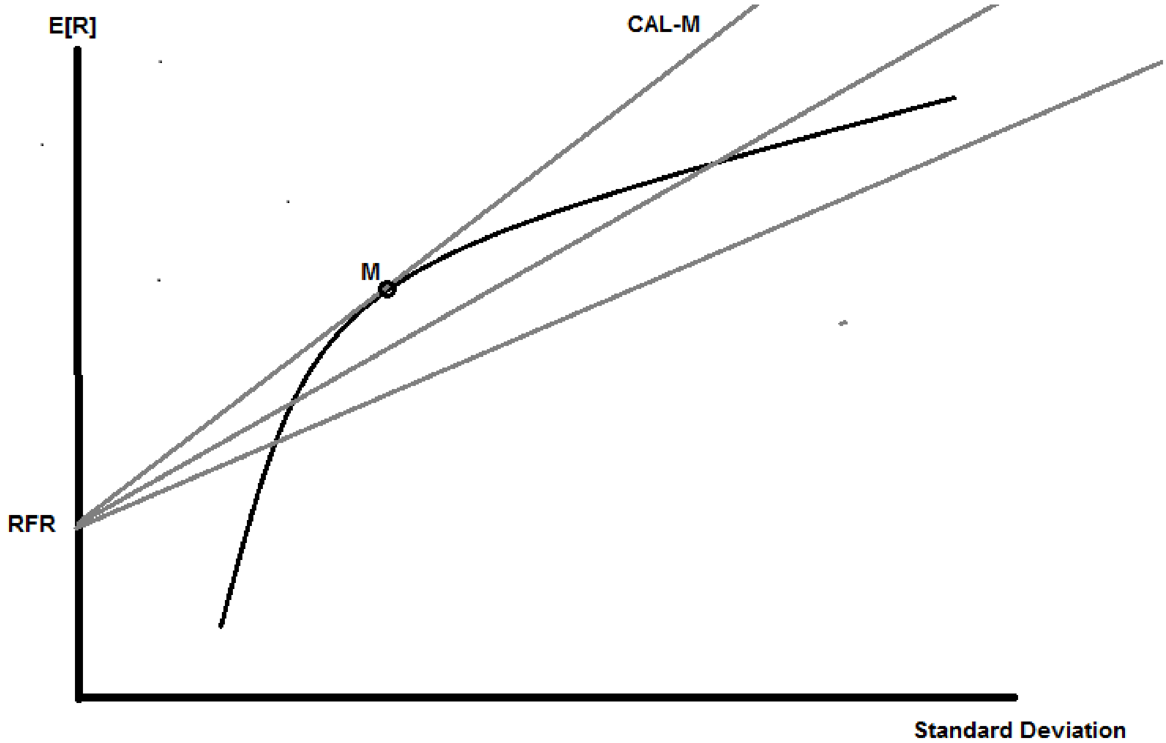
$$\sigma_p^2 = w_r^2 \sigma_r^2 \quad (46)$$

[593] *Proportion of capital invested in the risky portfolio.*

[594] *Proportion of capital invested in the risk free asset.*

12. Intuitively, equation $E[R_p]$ and σ_p^2 imply that when a risky security or portfolio is combined with a risk free asset, the risk and return is proportional to the amount invested in the risky component. [595] Note that equation $E[R_p]$ and σ_p^2 imply investors are able to borrow funds at the risk free rate, which occurs if $w_r > 1$. Graphically, this relationship implies that an investor can obtain any risk-return combination along the straight line between a risk free asset and a given portfolio of risky assets, by varying w_r and w_{rf}. This relationship is shown below in is referred to as the Capital Allocation Line (CAL). With the addition of the risk free asset, it can be shown that an optimal portfolio of stocks exist, which combined with a risk free asset has a superior expected return per unit of risk. Figure 26 below shows various CAL for various risky portfolios, with portfolio M clearly being superior to all other portfolios:

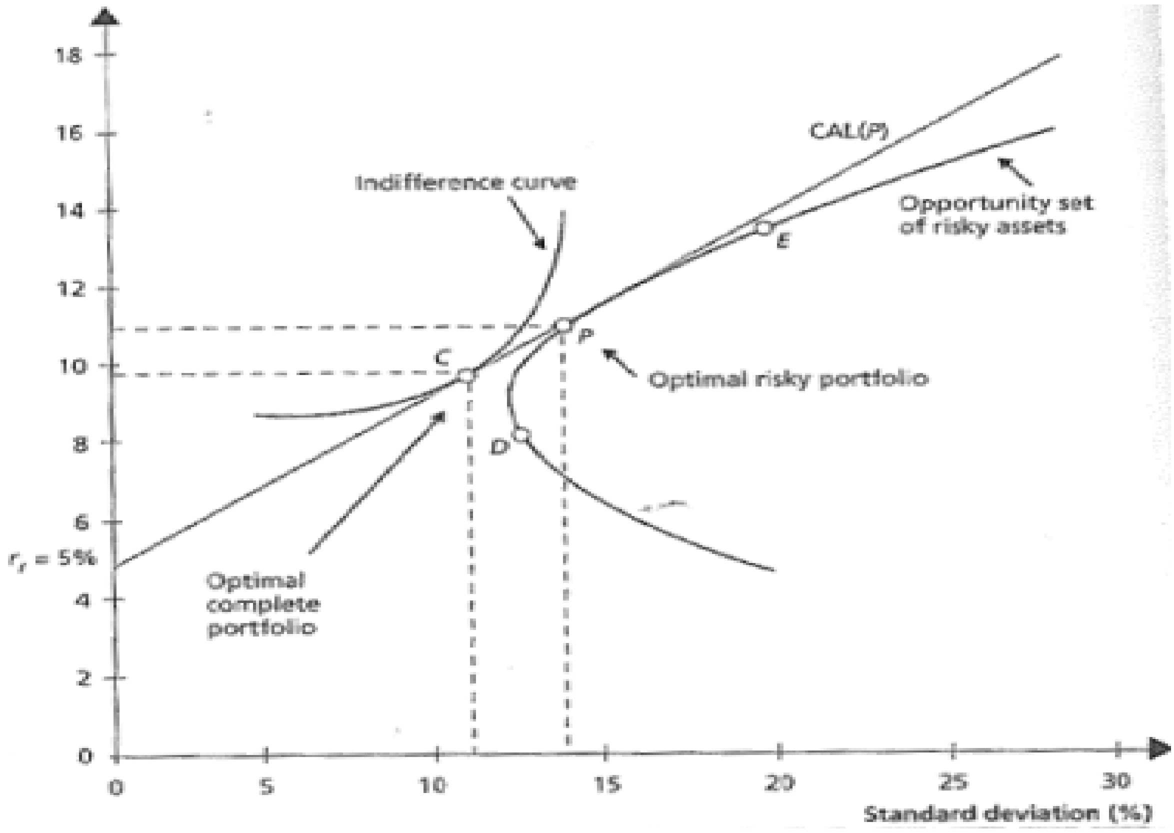
Figure 26 Portfolio possibilities with Risk Free Asset



13. By allocating capital between the risk-free asset and this optimal portfolio, the superior expected return per unit of risk ratio can be preserved. The investors desired level of risk can be achieved via this mechanism. As a consequence, all rational investors who seek to maximise the expected return per unit of risk will choose to hold a proportion of their capital in this optimal portfolio, and the remaining proportion in the risk free asset. By choosing the proportions of capital allocated between the optimal portfolio and risk-free asset, the desired level of risk can be achieved that maximises expected return, as determined by the investors utility function.

[595] Sharp, W.F (1985), *Investments Third Edition,* Prentice-Hall, New Jersey, p. 135.

Figure 27 Capital Market Line



14. As presented in Figure 27, the allocation of capital between the optimal risky portfolio, P, and the risk-free asset is shown above in the capital market line (CML). Point P represents the optimal portfolio that maximises the expected return per unit of risk. Given that the CML dominates the efficient frontier of risky assets, investors are able to achieve superior risk return combinations by investing in both the risk-free asset and the optimal portfolio. The choice of portfolio is determined by the investor's indifference curve, which represents the risk-return combinations that give the investor the same level of utility as calculated by their utility function. A rational investor will attain the highest indifference curve possible, representing the highest level of utility possible from investing. Therefore, an investor will allocate their capital at point C above, where the highest possible indifference curve is tangent to the capital market line.

15. The optimal portfolio is known as the market portfolio as this portfolio must contain all risky assets. Given that diversification reduces the unsystematic risk of the portfolio, only systematic risk remains in a diversified portfolio. It is assumed that diversification is costless, and as a consequence, return is only achieved by bearing systematic risk. The optimal portfolio will therefore only compensate investors for bearing systematic risk, as unsystematic risk is costless to diversify away. As systematic risk is market risk, the fully diversified portfolio will contain only macroeconomic risks, and as a consequence investors will only earn a return for bearing macroeconomic risks.

16. The expected return of the risk-free asset corresponds to an asset having a beta of zero because a risk-free asset faces no systematic risk. The return of the market portfolio as a whole corresponds to a beta of 1, as by definition the market portfolio is the benchmark for systematic risk. Assuming that the return of an

individual asset is linearly related to its β, these 2 points can be used to construct the Security Market Line (SML) as follows:

$$SML: E[R_i] = R_f + \beta_i (E[R_m] - R_f) \quad (47)$$

where

$E[R_i]$ is the expected return of security i;

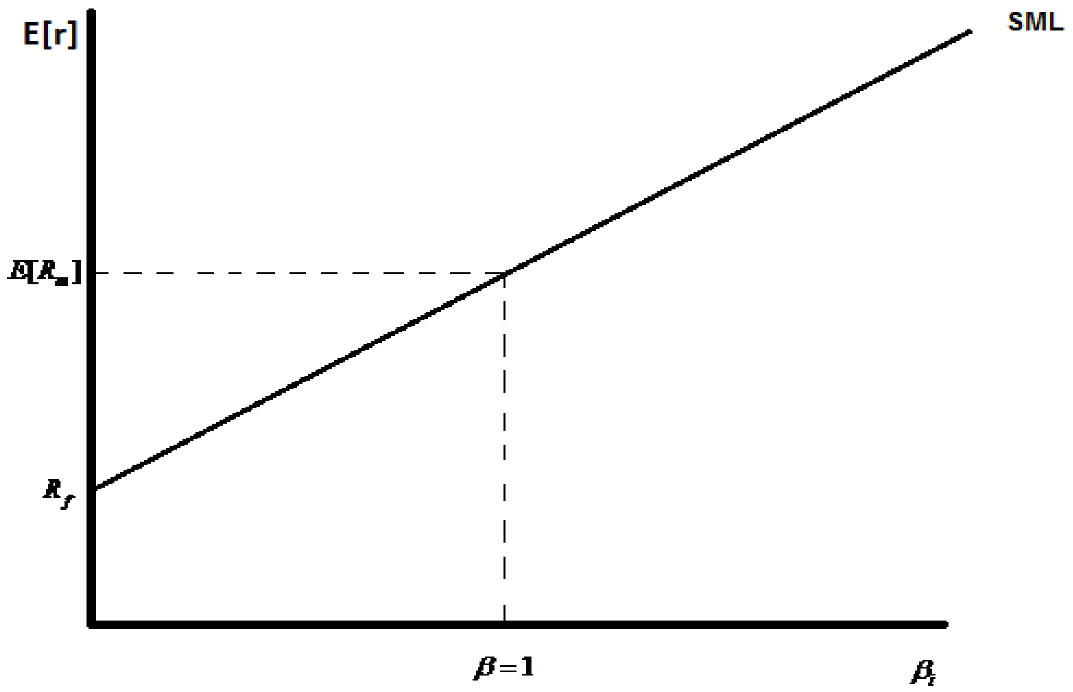
R_f is the risk free rate of return;

β_i is a measure of the systematic risk present in security i;and

$E[R_m]$ is the expected market return.

17. The difference between the expected return for security i and a risk-free rate of return, $E[R_m] - R_f$, is generally referred to as the market risk premium (MRP). The MRP represents the premium investors earn over and above the risk-free rate of return for bearing systematic risk. This situation can be represented graphically showing the relationship between a securities expected return $E[R_i]$ and a security β. As a result, the intercept represents the risk-free rate of return, whilst the slope of the SML is the market risk premium. The SML representation in Figure 28 is also known as the Sharpe-Lintner CAPM.

Figure 28 Security Market Line



18. The Capital Asset Pricing Model (CAPM) can be derived from the above modern portfolio theory framework. The traditional "Sharp-Linter CAPM" is derived from the following assumptions:[596]

- Investors are price takers

[596] Bodie. Z, Kane.A and Marcus A.J 1999, *Investments fourth edition,* Irwin/McGraw-Hill, p251

- All investors invest for one holding period (myopic behaviour).
- Investments are limited to publically traded assets, and they all capable of investing/borrowing at the risk free rate.
- Investors pay no taxes or have any transaction costs.
- All investors are rational mean-variance optimizers, ie rely on the above modern portfolio theory framework.
- All investors have identical estimates of the probability distribution of asset returns (Homogeneous expectations).

19. In order to derive the CAPM relationship, consider an investor who has 100% of his capital allocated in the market portfolio (earning an expected return, $E[R_m]$ for given variance σ_m^2), and increases his position by an infinitesimal amount, δ which the investors finances by borrowing at the risk free rate, r_f.[597] In this situation, the new portfolio has an expected return and variance of:

$$E[R_m]+\delta(E[R_m]-r_f) \quad (48)$$

$$\sigma_p^2=\sigma_M^2+(2\delta+\delta^2)\sigma_M^2 \quad (49)$$

20. The incremental change in expected return and variance is:

$$\Delta E[R_p]=\delta(E[R_m]-r_f) \quad (50)$$

$$\Delta\sigma_p^2=(2\delta)\sigma_M^2 \quad (51)$$ [598]

21. Dividing the equation above by its preceding one we can derive an “incremental risk premium” which is referred to as the marginal price of risk as follows:

$$\frac{\Delta E[R_p]}{\Delta\sigma_p^2}=\frac{(E[R_m]-r_f)}{2\sigma_M^2} \quad (52)$$

22. Similarly, consider an investor who instead invests the increment δ, in an asset X_i. The incremental return and incremental variance in this case is as follows:

$$\Delta E[R_p]=\delta(E[R_i]-r_f) \quad (53)$$

$$\Delta\sigma_p^2=(2\delta)\,\mathrm{Cov}(R_i,R_m) \quad (54)$$

23. In this situation, the marginal increase in risk due to asset X_i (marginal price of risk) is:

$$\frac{\Delta E[R_p]}{\Delta\sigma_p^2}=\frac{(E[R_i]-r_f)}{2\,\mathrm{Cov}(R_i,R_m)} \quad (55)$$

[597] Ibid, p257

[598] *The square of an infinitesimal quantity,* δ^2 *, is assumed to be 0*

24. For equilibrium to occur in capital markets, the marginal price of risk due the addition of asset X_i must equal the marginal price of risk due to the addition of the market portfolio (i.e. equation 52 must equal equation 55). If this was false, investors can invest in asset X_i to earn superior returns per unit of risk. Therefore, equation the marginal price of risk due to asset X_i and that due to the market portfolio results in:

$$\frac{(E[R_i]-r_f)}{2\,\mathrm{Cov}(R_i,R_m)}=\frac{(E[R_m]-r_f)}{2\sigma_M^2} \qquad (56)$$

25. Solving equation (56) for $E[R_i]$ results in:

$$E[R_i]=r_f+\frac{\mathrm{Cov}(R_i,R_m)}{\sigma_M^2}[E[R_m]-r_f] \qquad (57)$$

26. By defining $\beta_i=\frac{\mathrm{Cov}(R_i,R_m)}{\sigma_m^2}$ we have the Sharp-Lintner CAPM:

$$E[R_i]=r_f+\beta_i[E[R_m]-r_f] \qquad (58)$$

27. From the above analysis, the return of an individual security is related to the covariance the security has with the returns of the market portfolio. As investors earn no return for bearing unsystematic risk, it follows that the return of an individual security will be related to the degree of systematic risk inherent in the security. The covariance between the market portfolio and the individual security represents the degree of systematic risk presented in the individual security. The sensitivity between a security and the market is referred to as a beta, β and this beta represents the degree of systematic risk presented in a security.

Appendix 13 Flight to Quality: An Empirical Evidence in the Australian Financial Market

Literature review

1. Academic studies have shown considerable empirical evidence in support of a ‘flight-to-quality’, shown by a negative correlation between the equities markets and bond markets during times of uncertainty within equities markets around the world.

2. Chordia, Sarkar and Subrahmanyam examined the impact of financial crises, monetary policy and mutual fund flows on financial market liquidity over 17 June 1991 to 31 December 1998. The authors observed that financial crises, such as the Asian Financial Crisis (from 1 October to 31 December 1997) and the Russian Default Crisis (from 6 July to 31 December 1998) are accompanied by a decrease in fund flows to equity funds and an increase in flows to the American Government bond funds, resulting in higher bond market liquidity. The authors concluded that this evidence supports a “flight-to-quality” during times of financial uncertainty.[599]

3. Gulko tested the hypothesis that the stock-bond correlation is positive before equity market crashes and negative in the aftermath. The author examined daily returns of the Standard and Poor’s (S&P) 500 Index and the on-the-run United States (US) Treasuries, the most frequently traded bonds, over 1946 – 2000. A short run event study around equity market crashes was constructed. The author defined equity market crashes as where the S&P 500 index decreased by more than five per cent in a single trading day. The author reported a statistically significant positive correlation between equities and bonds for the ten trading day period before crashes, which reversed in the period spanning two days before crashes until ten days after. The author interpreted this as evidence supporting a ‘decoupling’ between the two markets as investors flee to the relative safety offered by American Government Bonds.[600]

4. Li examined the correlation between daily observed returns on equity and long-term government bonds over the period from 1958 to 2001 for the G-7 nations, including France, Germany, Italy, Japan, The United Kingdom, US and Canada. Equity indices are value-weighed broad market indices whereas the long-term bond indices are used to represent the benchmark government bond indices. A perfect correlation of one (either positive or negative) means that if the market for equity (bond) moves a given amount in a given direction, the market for bond (equity) will also move in perfect synchronisation. The author observed that the degree of correlation between the two markets was ranged from 0.2 to 0.3, meaning that movements in the stock market were mirrored in the bond markets to a degree of 20 per cent to 30 per cent.[601]

5. Illmanen examined the yearly correlation between the US stock market, approximated by the S&P 500 Index, and the bond market, approximated by the 20-year Treasury bonds over December 1926 to December 2001. The author

[599] Chordia T, Sarkar A & Subrahmayam A, 2001, Common Determinants of Bond and Stock Market Liquidity: The Impact of Financial Crises, Monetary Policy, and Mutual Fund Flows, working paper.

[600] Gulko L, 2002, Decoupling, *The Journal of Portfolio Management*, Vol 28, No. 3. pp 59-66.

[601] Li L, 2002, Macroeconomic Factors and the Correlation of Stock and Bond Returns, Yale ICF Working paper No. 02-46.

reported that while the correlation between the two tends to be positive, there are periods of negative correlations, 1929 – 1932, 1956 – 1965 and 1998 – 2001. The author interpreted this as evidence of a 'decoupling' between the two markets in times of uncertainty.[602]

6. Dopfel examined the monthly stock and bond index correlation in the United States over January 1976 to December 2002. Equity returns were based on the S&P500 Index and bonds from the Lehman Brothers Aggregate Bond Index. The author observed that while the correlation was positive on average, there were four years when a negative correlation between the two markets was observed, including 1987, 1998, 2001 and 2002. The author interpreted this as evidence in support of a decoupling of the two markets in times of crisis as investors seek a flight-to-quality from equities markets into bond markets.[603]

7. Connolly, Stivers and Sun examined whether equity market uncertainty, approximated by volatility, affects equity and bond market correlation. The authors examined daily equity data over 1988 to 2000 using the Chicago Board Options Exchange (CBOE) Volatility Index, calculated from the implied volatility of S&P100 index options. Bond data was taken from 10 year and 30 year US Treasury bond yields. The authors observed that in periods where volatility is low, equities and bonds display a positive and reliable correlation. However, the correlation reverses when volatility is high. The authors also observed that bond returns and changes in volatility are positively related, suggesting that investors rebalance their portfolio towards bonds in times of high equity market uncertainty.[604]

8. Baur and Lucey examined the existence of a "flight-to-quality" phenomenon within European and American markets over 30 November 1995 to 30 November 2005. The authors used daily returns from MSCI stock and bond indexes MSCI Bond indexes represent total sovereign returns for bonds with maturities greater than ten years. The authors observe a negative correlation for transitory periods around market crises including the October 1997 equities market crashes, the Russian crisis in June 1998, the introduction of the Euro in January 1999 and 2002, the 2011 September 11 terrorist attacks and the beginning of the war in Iraq in March 2003. The authors observe changes in the magnitude of the correlation of as much as 0.6 within a period as short as 20 trading days and interpreted this as evidence that equity and bond markets can decouple quickly.[605]

9. Kim, Moshirian and Wu observed a consistent role of stock market uncertainty in many European markets. The authors used implied volatilities from the Chicago Board of Option Exchange's Volatility Index and Germany's DAX Equity Index as a proxy for uncertainty in equities markets. Total daily return on the government bond indexes for bonds with maturities greater than ten years from 2 March 1994 to 19 September 2003 were used. The finding from the study is that the stock and bond market integration has trended downwards towards zero and even into negative territory in most European markets. This observation is consistent with

[602] Illmanen A, 2003, Stock-Bond Correlations, *The Journal of Fixed Income*, Vol 13, No. 2, pp. 55 – 66.
[603] Dopfel F, 2003, Asset Allocation in a Lower Stock-Bond Correlation Environment, *The Journal of Portfolio Management*, Vol 30, No. 1. pp. 25-38.
[604] Connolly, R, Stivers, C & Sun, L. (2005). Stock Market Uncertainty and the Stock-Bond Relation, *The Journal of Financial and Quantitative Analysis*, Vol 40, No. 1, pp. 161-194.
[605] Baur D & Lucey B, 2009, Flight-to-quality or Contagion? An Empirical Analysis of Stock-Bond correlations, *Journal of Financial Stability*, Vol 5, No. 4. pp. 339-352.

findings from other studies which provide evidence supporting the validity of a flight-to-quality phenomenon.[606]

10. In conclusion, the above literature reviewed is in consensus of evidence of a positive correlation between equity and bond markets. However, during times of crisis or uncertainty within equities markets, the two markets 'decouple', resulting in a negative correlation as investors seek the liquid and safer assets within the bond market.

11. Dungey, McKenzie and Tambakis (2009) specified a threshold auto-regression conditional heteroskedasticity model (TARCH) to test for sign bias in the effect of negative return shocks in emerging stock markets on US Treasury bond yield volatility. They proposed that negative shocks in the returns from developing equity markets should lead to significant positive volatility responses in US Treasury bond yields. They developed specifications to test the hypothesis for a range of maturities in US Treasury bonds, corresponding to a range of emerging equity markets. Their results tended to find evidence in support of their proposition in all but the longest dated US Treasury debt instruments in their study. These findings supported their theoretical model of a flight-to-quality between emerging stock markets and US Treasury bonds.[607]

Methodology

12. The most common methodology in the flight-to-quality literature is to investigate whether there is a negative relationship between government bond prices and equity returns in order to find evidence of funds moving rapidly from a domestic equity market into domestic Government bonds.

13. The following model is specified:

$$\%\Delta BY_t = \alpha + \beta_0 R_{m,t} + \varepsilon_t \qquad (59)$$

14. The dependent variable $\%\Delta BY_t$ is the per cent change in bond yields from day t-1 to day t that is from the day before to the day after. The pricing convention in the Australian market for Treasury bonds is in yields. Negative values of $\%\Delta BY_t$ therefore indicate an increase in the bond's price.

15. The intercept α represents the average difference between daily yield changes and equity market returns. Although it is reported, it is not of any interest in the context of this study.

16. The independent variable $R_{m,t}$ is the return on the domestic equity market between day t-1 and day t. A negative value of $R_{m,t}$ implies a fall in the equity market index between yesterday and today.

606 Kim SJ, Moshirian F & Wu E, 2006, Evolution of International Stock and Bond Market Integration: Influence of the European Monetary Union, *Journal of Banking and Finance*, 30:5, pp.1507-1534.

607 Dungey M, McKenzie M & Tambakis D, 2009, Flight-to-Quality and Asymmetric Volatility Responses in US Treasuries, *Global Finance Journal*, No. 19, pp. 252-267.

17. Following Gulko's methodology, a crash day is defined as a day where the market index loses five percent or more of its value.[608]

18. Equation (59) is estimated three times:

- once for observations falling in the event window. The event window is as starting two days before this day and finishes ten days after this day. If another crash occurs between the crash day and day ten after the crash, day ten is reset to occur ten days after the latest crash;
- once for observations falling in the prologue. The prologue is defined is defined as ten days before the event window; and
- once for the epilogue (the period after the event window) is defined as the ten days after.

19. The event window is defined as starting two days before this crash day and finishes ten days after this crash day. If another crash occurs between the crash day and day ten after the crash, day ten is reset to occur ten days after the latest crash. The prologue is the period before the event window while epilogue is the period after the event window.

20. Gulko's study used changes in bond prices (as opposed to yields) in equation (59) which represents changes in yields. The implication of this difference is that the sign of Gulko's β will be inverse to the sign of β as presented in (59). Gulko's study found that β is significantly positive during prologue and epilogue, but significantly negative during the crash window. The findings of Gulko's paper concluded that stock-bond correlation switches sign from positive to negative during stock market crashes with high probability. Since β in (59) is inversely related to Gulko's β, our hypothesis is formulated inversely. Accordingly, the following hypothesis to test for flight-to-quality responses in the Australian equity market and Government Treasuries is:

Hypothesis (iii)

In equation (1), β is significantly negative during the prologue and epilogue, but significantly positive during the crash window.

Data

21. The All Ordinaries (non-accumulation) price and 10-year Australian Commonwealth Government bond yield indices were sourced from Bloomberg. Each observation represents the last trading day closing observation available. The full set of daily observations covers the period from 30 September 1983 to 25 January 2013.

22. Daily bond yield changes were calculated using the continuous[609] daily percentage change:

[608] Gulko L, 2002, Decoupling, *The Journal of Portfolio Management*, Vol 28, No. 3. p 60

[609] Continuous per cent changes are preferred in regression analysis due to their symmetrical properties in increases and decreases.

$$\%\Delta BY_t = \ln\left(\frac{y_t}{y_{t-1}}\right) \quad (60)$$

Where:

y_t is the last closing yield available on trading day t.

23. Daily market returns (ie the daily percent change in price) are calculated as:

$$R_{m,t} = \ln\left(\frac{p_t}{p_{t-1}}\right) \quad (61)$$

Where:

p_t is the last closing index price available on trading day t.

24. Table 42 shows that across the whole period of 7,650 observations on average, daily market returns were positive at 0.025 per cent (prices tended to increase each day), where as bond yields tended to decline over the same period (- 0.019 per cent).

25. The largest negative daily market return was around 29 per cent, whereas the largest daily gain was only around 6 per cent. Bond yields are more symmetric in their extremes with daily change maximum and minimums being in the order of -7.5 and 7.5 percent respectively.

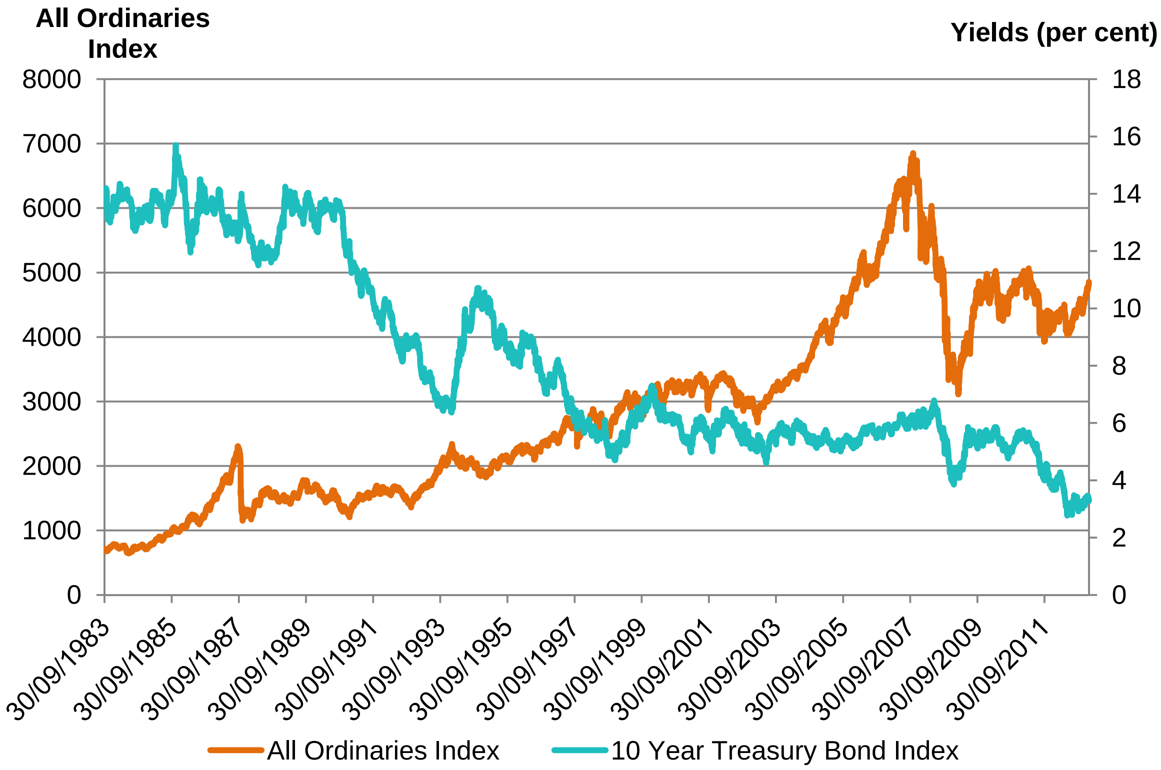
Table 42 Descriptive Statistics - Full Data Set: September 1983 to January 2013

	Market Return	Bond Yield Change
Mean	0.025%	-0.019%
Mean t-statistic	2.21	-1.51
Median	0.028%	0.000%
Mode	0.000%	0.000%
Standard Deviation	0.989%	1.100%
Range	34.830%	15.038%
Minimum	-28.761%	-7.398%
Maximum	6.069%	7.640%
Sum	191%	-145%
Count	7650	7650

Source: Economic Regulation Authority's analysis

26. The behaviour of the changes in the series is reflected in the market index and bond yield trends plotted in Figure 29. Over the entire period, the All Ordinaries index has trended up while bond yields have trended down.

Figure 29 Australian Stock Market and Treasury Bond Index Trends: September 1983 to January 2013



27. As per Gulko's study, three subsets of data were extracted from the full set consisting of:

- the crash period;
- prologue period (period before the crash); and
- epilogue (period after the crash).

28. A crash is defined as any day where the index loses more than 5 per cent of its value. The crash period is defined as that day, the two days before that day and ten days after that day making a crash period thirteen days long, provided another crash did not occur within the crash period. If another crash did occur within a crash period, then the period is extended to include another ten days after that crash and so forth.

29. The prologue period is defined as the ten days before a crash period while the epilogue is defined as ten days after the crash period.

30. The dates corresponding to the crash are outlined in Table 43 below:

Table 43 Australian Equity Market Crash Dates and Descriptions

Date	All Ordinaries Index	10 Year Treasury Bond Yield Index	Market Return	Bond Yield Change	Event
20/10/1987	1549	13.75	-28.76%	4.46%	1987 Wall Street Crash
23/10/1987	1514	13.3	-7.30%	0.00%	
26/10/1987	1415	13.1	-6.78%	-1.52%	
27/10/1987	1317	13.5	-7.20%	3.01%	
29/10/1987	1284	14	-7.82%	2.53%	
4/11/1987	1290	13.65	-5.63%	0.00%	
16/10/1989	1601	14.002	-8.44%	0.00%	United Airlines Leveraged Buy Out Failure
28/10/1997	2299	6.045	-7.45%	4.22%	Asian Financial Crisis
17/04/2000	2920	6.098	-5.85%	-1.51%	'Dot Com' Bubble
22/01/2008	5222	5.872	-7.54%	-2.62%	Global Financial Crisis
8/10/2008	4370	4.931	-5.09%	-2.58%	
10/10/2008	3940	5.139	-8.55%	0.98%	
16/10/2008	3988	5.248	-6.89%	-2.35%	
13/11/2008	3672	4.909	-5.59%	-3.50%	

Source: Bloomberg and Economic Regulation Authority's analysis

31. October 1987 witnessed one of the most spectacular stock market crashes on record as stock exchanges worldwide recorded some of the largest one day declines in history. While there is no consensus to its cause, some factors considered to contribute to the cause include widespread contagion, a lack of liquidity and an extended period of overvaluation in stock prices prior to the crash.

32. The October 1989 crash was triggered by the breakdown of the United Airlines leveraged buyout. The breakdown of the United Airlines buyout triggered a collapse in the junk bond market as the announcement that the buyout group could not secure the requisite amount of debt financing caused widespread contagion as investors withdrew their money from the equity and bond markets.

33. The October 1997 crash was triggered by the Asian Financial Crisis which saw large currency depreciations and defaults in many Asian countries. The crisis started in Thailand with the collapse of their sovereign currency, which triggered widespread depreciations in currencies, equities markets and asset price across most of the Southeast Asian nations.

34. The April 2000 crash was triggered by the popping of the 'dot com' bubble, a speculative bubble in internet stocks within the NASDAQ from 1995 to 2000. The bubble was characterised by overvaluations and irrational exuberance towards internet based stocks which was started by rapidly increasing stock prices, overconfidence and widely available venture capital for internet based stocks.

35. The 2008 stock market crash was caused by the onset of the 2008 Global Financial Crisis. This crisis was triggered a combination of the United States subprime mortgage crisis, the effect of which was spread worldwide by securitisation causing a liquidity crisis in the credit market. This eventually caused the bankruptcy of many major financial institutions, such as Lehman Brothers, Fannie Mae, Freddie Mac and Bear Stearns.

36. Descriptive statistics for the 108 observations falling in the crash periods are outlined in Table 44 below. Daily market returns in this period are significantly negative on average as expected, while daily changes in bond yields are also negative on average, although these changes appear not to be significantly different from zero as indicated by the mean t-statistic, median change and sum of changes. The major changes in stock returns (minimum of bond yields (minimum of-7.398 per cent and maximum of 7.640 per cent) and bond yields (minimum of -28.761 and maximum of 6.069 per cent) from the full data set are incorporated within the crash period set.

Table 44 Australian Equity Market Crash Period Data Set

	Market Return	Bond Yield Change
Mean	-0.879%	-0.067%
Mean t-statistic	-2.11	-0.35
Median	-0.256%	0.000%
Mode	0.000%	0.000%
Standard Deviation	4.322%	1.971%
Range	34.830%	15.038%
Minimum	-28.761%	-7.398%
Maximum	6.069%	7.640%
Sum	-95%	-7%
Count	108	108

Source: Bloomberg and Economic Regulation Authority's analysis

37. Prior to the crash, descriptive statistics (see Table 45) based on the 70 observations show that the average change in both series are of the same sign, but not of a large magnitude. The ranges and volatility of these series (as shown by the standard deviation) appear to be more closely aligned than during the crash period above.

Table 45 Descriptive Statistics - Prologue Data Set

	Market Return	Bond Yield Change
Mean	-0.182%	-0.099%
Mean t-statistic	-0.92	-0.54
Median	-0.234%	0.000%
Mode	NA	0.000%
Standard Deviation	1.651%	1.524%
Range	9.059%	9.448%
Minimum	-4.391%	-4.848%
Maximum	4.668%	4.600%
Sum	-13%	-7%
Count	70	70

Source: Bloomberg and Economic Regulation Authority's analysis

38. In the period after the crash, descriptive statistics in Table 46 below show a similar situation to that in prologue. The average change in both series is of the

same sign, but not of a large magnitude while the ranges and standard deviations are more aligned than those in the crash.

Table 46 Descriptive Statistics - Epilogue Data Set

	Market Return	Bond Yield Change
Mean	-0.186%	-0.145%
Mean t-statistic	-0.88	-0.80
Median	-0.192%	0.000%
Mode	NA	0.000%
Standard Deviation	1.777%	1.520%
Range	10.259%	8.773%
Minimum	-5.592%	-4.438%
Maximum	4.668%	4.335%
Sum	-13%	-10%
Count	70	70

Source: Bloomberg and Economic Regulation Authority's analysis

39. The overall picture from these statistics is that daily changes in bond yields tend to respond mildly to crashes in the stock market, but these changes appear to behave in a comparable way to stocks returns.

Results

40. Equation (59) was run on the full data set and the subsets, prologue, crash and epilogue to test Hypothesis (i). Results are shown in Table 47. The three components of the hypothesis are rejected:

- The beta regression coefficient in the prologue subset is significantly *positive* – the hypothesis requires it to be significantly *negative*.
- Beta is not significantly different from zero during in the crash subset – the hypothesis requires it to be significantly positive.
- Beta in the epilogue is significantly *positive*

  – the hypothesis requires it to be significantly *negative.*

Table 47 Regression Results

Period	Beta	p-value	R-square	Observations
Full Set	0.0789	0.0000	0.0050	7,650
Prologue	0.4614	0.0000	0.2499	70
Crash	-0.0040	0.9277	0.0001	108
Epilogue	0.4315	0.0000	0.2545	70

Source: Bloomberg and Economic Regulation Authority's analysis

41. The full data set estimate is positive and significant at 1 per cent. This indicates that over the whole period, bond yields tend to change in the same direction as stock prices. Another interpretation is that bond prices tend to change in the opposite direction of stock prices over the whole period. This relationship appears to move closer towards a one to one co-movement during the prologue, disappears entirely during the crash and returns toward a one to one co-movement after the crash.

Conclusion

42. The 'flight-to-quality' hypothesis as formulated by Gulko is rejected in the Australian Market.

43. The results from this study suggest that, in general, there tends to be some positive co-movement between stock prices and Treasury bond yields in Australia. In the days before a crash, it appears that the co-movement is more direct between the two markets, but this co-movement completely breaks down during the days that closely surround a crash. In the epilogue, similar co-movement between the markets appears to return.

44. Gulko's analysis was carried out on the US market. The US is perceived as a 'safe haven' thus it may experience net capital inflows from the rest of the world into its safest assets.[610] Post 1987, the US Treasury bonds became the safe investment of choice over gold.[611] Conversely, Australia is a very small market without the reputation of the US as a safe haven during times of heightened uncertainty. A possible explanation for the above results is that the 'flight-to-quality' effect may see funds leaving the Australian market destined for investment in markets that are perceived as safe. Dungey, McKenzie and Tambakis' 2009 study found this to be the case between emerging equity markets and the US Treasury bond market.[612]

[610] Caballero and Kurlat, October 2008, Flight-to-quality and Bailouts: Policy Remarks and a Literature Review, Massachusetts Institute of Technology Department of Economics Working Paper 08-21, p.1.

[611] Gulko, 2002, Decoupling, The Journal of Portfolio Management, Vol 28, No. 3, pp.59-66

[612] Dungey M, McKenzie M & Tambakis D, 2009, Flight-to-Quality and Asymmetric Volatility Responses in US Treasuries, *Global Finance Journal*, No. 19, pp. 252-267

Appendix 14 Co-integration between Commonwealth Government Bond Yields and the Cash Rates

Introduction

1. On the advice of their consultants, regulated business submitted that a required rate of return on the regulatory decisions should be stable over time. The implication of this view is that an reduction in the risk free rate will be offset by a relative increase in the MRP, leaving the return on equity unchanged when the Sharpe-Lintner CAPM is adopted. In an econometric sense, this implication means that the risk free rate and the MRP should be co-integrated.

2. In a separate empirical study, the Authority failed to find empirical evidence to support the view that the CGS yields and the MRP are co-integrated. It is in contrast with claims made by regulated businesses. In this brief empirical test, the Authority has conducted the co-integration test between the CGS observed yields and the cash rates.

3. A stationary series is a series that tends to revert to a long run mean and variance. It is noted that two or more series that are non-stationary (i.e. they tends to follow a random walk when they are observed in isolation) may be linearly combined by adding or subtracting from each other to form a stationary series. The movements of the series in isolation may appear to be erratic but the differences between them may not be the case because the series may be 'anchored' to one another. Such a series is said to be co-integrated.

4. Co-integration does not necessarily mean correlation. In the shorter term, the series may move independently with each other. However, in the longer term, these series will tend to converge as if they were 'elastically tethered' together to prevent them from drifting too far apart.

5. The co-integration test is adopted to test the relationship between the overnight cash rate and the CGS bond yields. While the former series is typically fixed for periods of one month or more, the latter series moves frequently to reflect the market demand and supply forces.

6. The following equation is specified;

$$\varepsilon_t = CR_t - \phi Yield_{i,t} \qquad (62)$$

Where: t is the day in which the observation is observed;

i is the term to maturity of the Treasury, in this case, 5- or 10-year terms;

CR is the overnight cash rate on day t;

Yield is the corresponding CGS bond yield on day t; and

ϕ is the co-integrating coefficient (*phi*).

7. It is argued that if the cash rates and the Treasury bond yields series are co-integrated, the series ε_t will be known as being stationary.

8. The two-step Engel-Granger Augmented Dickey Fuller test for co-integration is carried out as follows.

- *First*, the series ε_t is created by running the following regression for both *i* equal to 5- and 10- year terms

$$CR_t = \alpha + \phi Yield_{i,t} + \varepsilon_t \qquad (63)$$

where α is a constantly observed difference between the overnight cash rate and the CGS bonds yields.

- *Second*, this step involves using the Augmented Dickey-Fuller test on residual series ε_t to test hypothesis (i) as stated below.

Hypothesis (i)

The series are non-stationary - that is they have a unit root.

9. Rejection of Hypothesis (i) suggests the two series are co-integrated and are bound together.

Data

10. The daily closing (trading day) annualised bid yield (*Yield*) on the 5- and 10-year Australian Government Bonds and the Reserve Bank of Australia's overnight cash rate were sourced from Bloomberg. The last available price[613] is used for each trading day observed on all data series. The data is outlined in Table 48 below.

Table 48 Cash Rate and Bond Yield Raw Data: October 1983 to April 2013

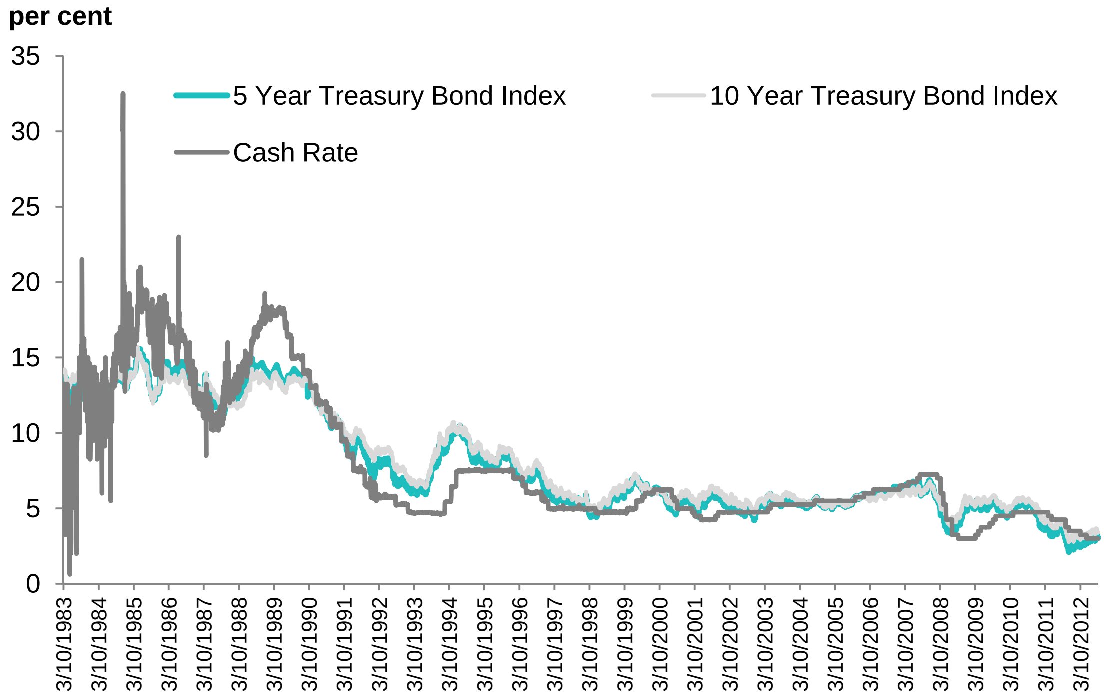
Description	Ticker	Observations
10 Year Australian Government Bond	GACGB10	7500
5 Year Australian Government Bond	GACGB5	7025
Australian Overnight Cash Rate	RBACOR	7380

Source: Bloomberg

11. The yields of the CGS bonds and the RBA's overnight cash rate are plotted below in Figure 30 to illustrate the relationship over the period.

[613] Bloomberg field 'PX_LAST'.

Figure 30 Overnight Cash Rate vs. 5 and 10 Year Bloomberg Treasury Bond Index



Source: Bloomberg

Results

12. The Augmented Dickey-Fuller unit root tests were carried out on the series ε_t estimated from (63). The results are presented in Table 49 and Table 50 below.

Table 49 Yield Series Regression Results

Regression	Observations	Intercept (alpha)	Yield Coefficient (phi)	R-Squared
10-Year Series	6946	-1.1315	1.0723	0.7893
p-value		0.0000	0.0000	
5- Year Series	6946	-0.9001	1.0789	0.8348
p-value		0.0000	0.0000	

Source: Economic Regulation Authority's analysis

13. The co-integrating coefficients on the CGS yields show that both CGS bond indices move similarly (1.07 for the 10-year and 1.08 for the 5-year series) with the cash rates. The results imply that the CGS yields move around one for one with the cash rate.

14. The intercept (alpha) on the 10-year series regression indicates that there is approximately 1.13 per cent premium over the cash rate on the 10-year bond and 0.9 per cent premium over the cash rate on the 5-year bond. This appears to be consistent with the intuition that a 10-year bond yields should provide a higher liquidity premium than a 5-year one.

Table 50 Augmented Dickey-Fuller Unit Root Tests: No Trend or Drift

Series	Observations	Test Statistic	Critical Value			Stationary
			1%	5%	10%	
10 Year Series	6946	-2.0925	-2.58	-1.95	-1.62	Yes
5 Year Series	6946	-1.9483	-2.58	-1.95	-1.62	Yes[614]

Source: Economic Regulation Authority's analysis

15. Absolute values of the test statistic greater than absolute critical values in Table 50 indicate rejection of the unit root hypothesis suggesting that the series ε_t are stationary. This suggests that both bond yields and the cash rate series are co-integrated.

Conclusion

16. Engel–Granger co-integration tests indicate that the overnight cash rate and 5-year and 10-year CGS bond yields series are co-integrated. The Authority is of the view that it is reasonable to assume that monetary policy acts independently of bond yields, given its informal (post 1993) and formal primary objective of targeting inflation. The CGS bond yields, however, are determined by markets which consider many macroeconomic variables including the RBA's overnight cash rates in the economy. From this perspective, it would be difficult to think of a scenario in which the causality runs from the CGS bond yields to the overnight cash rate (i.e. the CGS bond yields cause the RBA's cash rates).

17. This view, together with the above test results, tend to support the prevalence of the effect of the overnight cash rate on the CGS bond yields, given the strongly significant co-integrating coefficients of 1.07 to 1.08 which indicate an approximately one for one movement between the two series.

[614] At 10 per cent, on border at 5 per cent

Appendix 15 Co-integration between the Market Risk Premium and the Risk-free Rate of Return

Methodology

1. A single time series such as the yields on a bond may move in such a way that it does not revert to any long run mean or long run level of volatility. In the language of time series analysis, such a series is known as *non-stationary*. The implication is that the most recent observation in the series is the best predictor of tomorrow's value.

2. Two or more time series that exhibit such trends can at times have a stochastic trend in common - often exhibited over long periods of time. It can be the case that a linear combination of the two series produces a new stationary series, that is, one that tends to revert to some long run average and long run level of volatility. This implies that an equilibrium relationship exists between the series. Two series that exhibit such a characteristic are referred to as *co-integrated*.

3. In the case of the market returns and the risk free rate in the CAPM, the two series are tested to confirm whether or not they are co-integrated, in the sense that they share some long run stochastic trend. Intuitively, the risk free rate is not expected to rise above the market returns for an extended period of time. Conversely, the market returns is not expected to stay below the risk free rate for an extended period of time. One would expect a tendency for correction over the long run where the returns to investing in the market are sufficiently higher than risk free rate to compensate for the risks inherent in equity investment.

4. The following series is constructed:

$$\varepsilon_t = R_{m,t} - \phi Yield_t \tag{64}$$

where $R_{m,t}$ is the market return, $Yield_t$ is the corresponding bond yield on day t.

5. The initial assumption is that phi (ϕ) is equal to one.

6. Series (64) is tested for stationarity using the Dickey-Fuller Generalised Least Squares test. The following hypothesis is tested:

   Hypothesis (i)

   The series are non-stationary - that is they have a unit root.

7. Additionally, tests are carried out to relax the assumption that ϕ is equal to one using the two step Engel-Granger Augmented Dickey Fuller test for co-integration.

8. The first step involves running the following regressions:

$$R_{m,t} = \alpha + \phi Yield_t + \varepsilon_t \tag{65}$$

$$MRP_{m,t} = \alpha + \phi Yield_t + e_t \tag{66}$$

9. The second step involves using the Augmented Dickey-Fuller test on residual series ε_t and e_t to test hypothesis (i).

Data

10. The daily (trading day) annualised bid yield (Yield) on 5-year and 10-year Australian Government Bonds and daily closing price for the All Ordinaries accumulation index were sourced from Bloomberg. The last available price[615] is used for each trading day observation on all data series. The data is outlined in Table 51 below.

Table 51 Market Index and Bond Yield Raw Data: Acquired January 2013

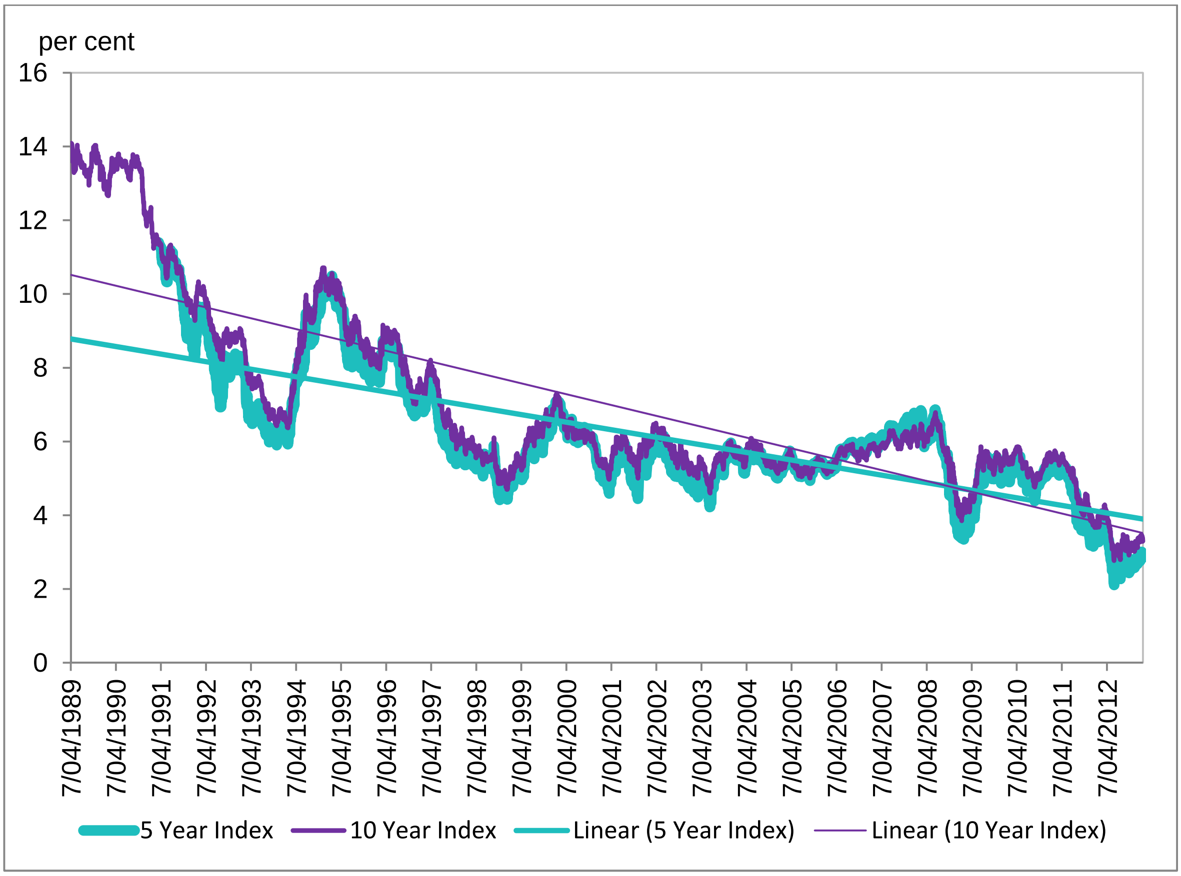
Description	Ticker	Source	From	To	Observations
10 Year Australian Government Bond	GACGB10	Bloomberg	7/04/1989	23/01/2013	7,195
5 Year Australian Government Bond	GACGB5	Bloomberg	19/03/1991	23/01/2013	6,688
All Ordinaries Accumulation Index	ASA30	Bloomberg	7/04/1989	23/01/2013	7,195

Source: Bloomberg

11. The yields of government bonds are plotted below in Figure 31 to illustrate the trends over time.

615 Bloomberg field ‘PX_LAST’.

Figure 31 Australian Commonwealth Government Bond Index Series 5 Year versus 10 Year 1989 to 2013



Source: Bloomberg and Economic Regulation Authority's analysis

12. Market returns were constructed for a 5-year and 10-year holding period by taking the natural log of the last closing price for 5 calendar years (or 10 for 10 year period) in the future divided by the present day's closing price. This continuous return is annualised by dividing by 5 for 5-year holding period (or 10 for 10-year holding period).

$$R_{m,t} = \ln\left(\frac{P_{t+5\,years}}{P_t}\right)/5 \qquad (67)$$

Where:

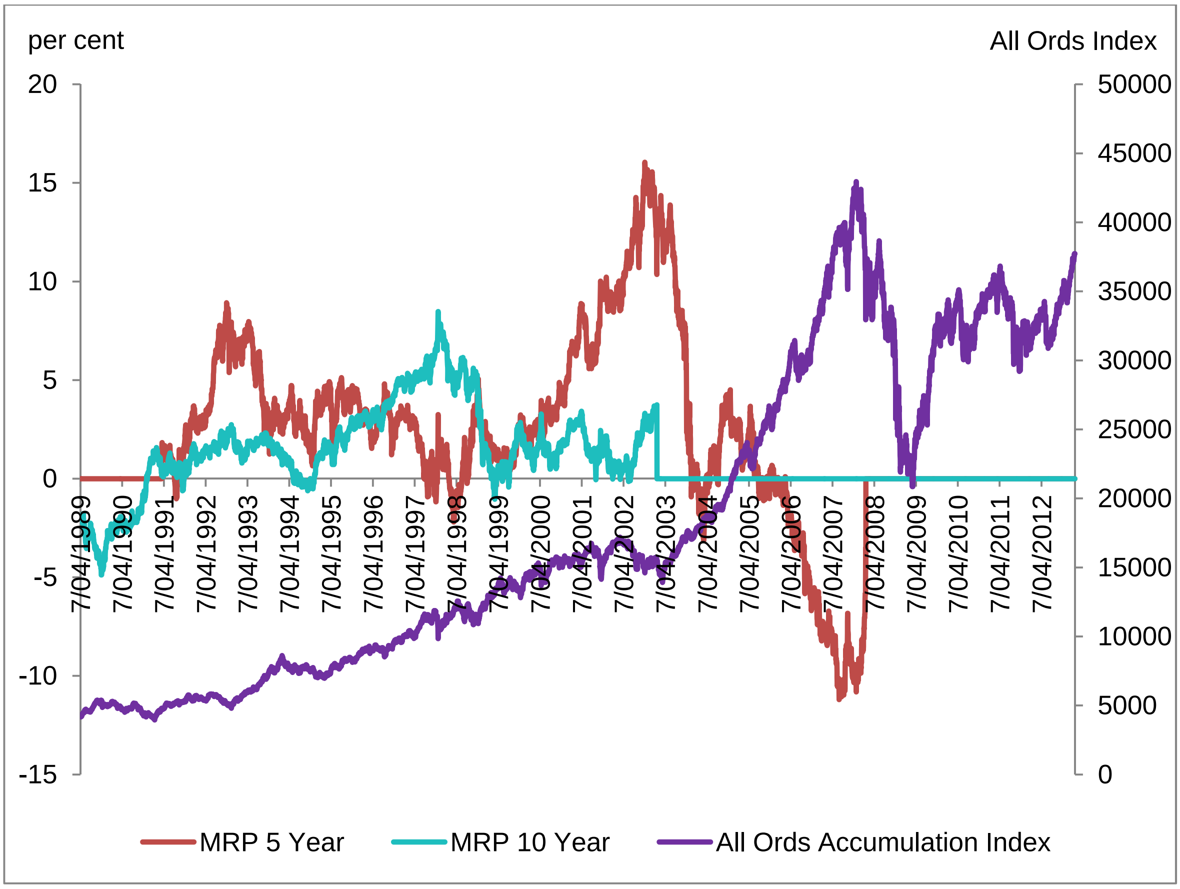
P_t is the last available daily closing price on day t.

13. The market risk premium is calculated by subtracting the present day's yield from the present day's return calculated in (67). This is done for both the 5 and 10 year series.

$$\mathrm{MRP}_t = \ln\left(\frac{P_{t+5\,years}}{P_t}\right)/5 - \mathrm{Yield}_t \qquad (68)$$

14. The resultant series from (68) for 5-year holding period and 10-year holding period is illustrated in Figure 32.

Figure 32 Market Risk Premium - Holding Period of 5 Years versus 10 Years - 1989 to 2013



Source: Economic Regulation Authority's analysis

Results

15. The Dickey-Fuller GLS unit root tests were carried on the series constructed from (64) assuming ϕ equal to one for both the 5-year and 10-year series. The results are shown in Table 52 below.

Table 52 Dickey-Fuller GLS Unit Root Tests: No Trend or Drift - ϕ = 1

Series	Observations	Test Statistic	Critical Value			Stationary
			1%	5%	10%	
5-Year Series	4,861	-1.3680	-2.57	-1.94	-1.62	No
10-Year Series	3,601	-0.7200	-2.57	-1.94	-1.62	No

Source: Economic Regulation Authority's analysis

16. The hypothesis that the series have a unit root cannot be rejected even at the 10 per cent level of significance. This suggests that in the 5-year and 10-year series, the market return and bond yield are *not* co-integrated. This conclusion implies that there is *no* long run equilibrium relationship between the two series observed over the period in which these observations are taken.

17. Before running regression (65) and (66) to test the residuals, Augmented Dickey-Fuller tests were carried out to determine whether the risk free rate and the

market return series alone were stationary. A trend was included in the test on the basis of the distinct declining trend exhibited over the periods in which all series were observed. The results are presented in Table 53.

Table 53 Augmented Dickey-Fuller Tests on Market Returns and Bond Yield Series with trend

Series	Observations	Test Statistic (tau)	Critical Value 1%	5%	10%	Stationary
5 Year Bond Yield Index	4861	-2.8053	-3.96	-3.41	-3.12	No
5 Year Market Returns	4861	-1.9297	-3.96	-3.41	-3.12	No
10 Year Bond Index	3601	-2.0686	-3.96	-3.41	-3.12	No
10 Year Market Returns	3601	-2.2897	-3.96	-3.41	-3.12	No

Source: Economic Regulation Authority's analysis

18. All of the tests do not reject the hypothesis of a having a unit root as demonstrated by the low values of the test statistics relative to the critical values in absolute terms.

19. Augmented Dickey-Fuller unit root tests were carried out on the residual series ε_t and e_t from regression (65) and (66) with the results presented in Table 54 below.

Table 54 Augmented Dickey-Fuller Unit Root Tests: No Trend or Drift - ϕ unconstrained

Series (Regression)	Observations	Test Statistic (tau)	Critical Value 1%	5%	10%	Stationary
5 Year Series (2)	4,861	-1.3424	-2.58	-1.95	-1.62	No
5 Year Series (3)	4,861	-1.3424	-2.58	-1.95	-1.62	No
10 Year Series (2)	3,601	-2.2600	-2.58	-1.95	-1.62	Yes
10 Year Series (3)	3,601	-2.2660	-2.58	-1.95	-1.62	Yes

Source: Economic Regulation Authority's analysis

20. Again, the 5-year series did not reject the hypothesis of no unit root as shown by the value of the test statistic being lower than even the value 10 per cent critical value in absolute terms.

21. The 10-year series however, rejected the hypothesis of a unit root at the 5 per cent level of significance. This suggests that the 10 year risk free rate and market returns/risk premium are co-integrated with the implication that a long term equilibrium relationship exists between them.

22. The regression results for (65) and (66) on the 10 year series are shown in Table 55.

Table 55 10-Year Yield Series Regression (65) and (66) Results

Regression	Observations	Intercept (alpha)	Yield Coefficient (phi)	R-Squared
10 Year Series (2)	3,601	6.3702	0.4222	0.2896
p-value		0.0000	0.0000	
10 Year Series (3)	3,601	6.3702	-0.5778	0.4329
p-value		0.0000	0.0000	

Source: Economic Regulation Authority's analysis

23. The intercept for both cases is highly significant at 6.37 per cent annualised return. The yield coefficient ϕ (known as the co-integrating coefficient) indicates a positive relationship between returns and the risk free rate. The sign of this result is intuitively appealing, given we expect that market returns consist of some premium over the risk free rate; market returns tend to rise when the risk free rate rises and vice versa. There is no obvious reason in practice however, why the coefficient should not equal one. Conversely, ϕ indicates a negative relationship between the market risk premium and risk free rate series.

24. These coefficients should be interpreted with caution. In addition to the nonsensical value of ϕ in (66) generally, these Ordinary Least Squares (**OLS**) estimates have a non-normal distribution meaning inference based on the student distribution can be misleading. While dynamic OLS estimates can resolve this latter issue, one would expect to see a value of one on the yield coefficient in regression (66).

Conclusion

25. There is no evidence to support a co-integrating relationship between the 5-year bond yield series and market return/risk premium series. Statistically, there appears to be a co-integrating relationship between the 10-year bond yield series and the corresponding market return/risk premium series when the co-integrating coefficient (ϕ) is not constrained to one. One must exercise caution in accepting the conclusion in the unconstrained analysis given the estimate for the coefficient on bond yields regressed against market returns is much less than one. From economic theory, common sense is relied up when carrying out co-integration tests. The estimate of -0.5778 for the co-integrating coefficient ϕ does not make economic sense because the MRP is considered as the market return less the *entire* risk free rate not *some proportion* of it. [616]

[616] Stock J and Watson, 2007, Introduction to Econometrics, Pearson Education, Boston MA, p. 661.

Appendix 16 The Market Risk Premium and the Risk-free Rate: Granger Causality Test

Methodology

1. The Granger causality test assumes that changes in variable X cause changes in variable Y based purely on precedence within a time series. If there is a relationship between changes in X and Y, and X *precedes* Y then X *Granger causes* Y based on the assumption that the future cannot predict the past. That is, if event A occurs before event B it is possible event A causes event B, but not vice versa. A commonly cited example of Granger causality which highlights the downfall of this assumption is that Christmas card sales precede Christmas, therefore Christmas card sales Granger cause Christmas.

$$\Delta \text{Yield}_t = \sum_{i=1}^{n} \alpha_i \Delta \text{MRP}_{t-i} + \sum_{i=1}^{n} \beta_i \Delta \text{Yield}_{t-j} + \varepsilon_{1t} \quad (69)$$

$$\Delta \text{MRP}_t = \sum_{i=1}^{n} \lambda_i \Delta \text{MRP}_{t-i} + \sum_{i=1}^{n} \delta_i \Delta \text{Yield}_{t-j} + \varepsilon_{2t} \quad (70)$$

2. In the context of bond yields (Yield) and the market risk premium[617] (MRP), equations (69) and (70) are regressed to determine whether (in aggregate) the coefficients on the lagged values of the respective variables are statistically different from zero. That is, the following hypotheses are tested:

Hypothesis (ii)

$$\alpha_1 = \alpha_2 = \ldots = \alpha_n = 0 \quad (71)$$

$$\delta_1 = \delta_2 = \ldots = \delta_n = 0 \quad (72)$$

3. An assumption is made on the number of lags to include in the regression (i.e. what *n* should be equal in (71) and (72). For example, if the data is daily and returns are only significantly affected by changes in yield from the previous day, in this case, the lag will only be one. If the MRP will be significantly affected by changes in yield on each day over the past business week, then the lag will be five to capture the five previous days.

- If the null hypothesis (71) is rejected, that is alpha is statistically different from zero, changes in the MRP Granger cause changes in Yield.
- If the null hypothesis (72) is rejected, that is delta is statistically different from zero, changes in Yield Granger cause the MRP.
- Rejecting both null hypotheses is evidence of *feedback* or *bilateral Granger causality*, that is both variables Granger cause each other.

[617] The equity return premium is the difference between the observed daily return and observed daily bond yield change, as opposed to the market risk premium which is the difference between the *expected* return and the bond yield over a longer time horizon.

- Failure to reject both null hypotheses suggests that the variables are independent.

Data

4. To test for Granger causality between changes in bond yields and changes in the market risk premium, the same raw series in Appendix 14 was used. The data is outlined in Table 51 above.

5. For this study, the 5-year and 10-year daily yield series were differenced by the previous day's observation as shown in (73).

$$\Delta \text{Yield}_t = \text{Yield}_t \text{-Yield}_{t\text{-1 } day} \tag{73}$$

6. The same was done for the market return outlined in (67) to create (74):

$$\Delta R_{m,t} = R_{m,t} \text{ - } R_{m,\ t\text{-1 } day} \tag{74}$$

7. These are the daily changes in returns (not prices).

8. The market risk premium series outlined in (68) was also differenced to derive (75):

$$\Delta \text{MRP}_t = \text{MRP}_t \text{-MRP}_{t\text{-1 } day} \tag{75}$$

9. These are the daily changes in the MRP (*not returns*).

10. The series (73) through to (75) are created for both 5 and 10 year holding periods. These series form the data required for the Granger Causality Test.

11. The test requires that both series are stationary and so augmented Dickey-Fuller tests are carried out on the differenced series to ensure this is the case.

12. Both series exhibit an absolute value of the t-statistic greater than the absolute value of the critical value and thus reject the null hypothesis of a unit root at the one percent level of significance. This implies that the series are stationary and suitable to use in the test as presented in Table 56 below.

Table 56 Augmented Dickey Fuller Unit Root Tests of Daily Changes: No Trend or Drift

Series	Test Statistic (tau)	Critical Value (1%)	Stationary
ΔYield (5 year)	-60.3947	-2.58	Yes
ΔYield (10 year)	-63.4847	-2.58	Yes
ΔMRP (5 year)	-49.6625	-2.58	Yes
ΔMRP (10 year)	-44.6409	-2.58	Yes

Source: Economic Regulation Authority's analysis

Results

13. The Granger causality test function of the MSBVAR package in R was used to test the relationships between the daily changes in the MRP and bond yields. The Akaike information criterion was used to determine the appropriate number of lags. The results are shown in Table 57.

Table 57 Granger Causality Test Results: MRP and Yield Differenced Series – Lag 1

Test	F-Statistic	P-Value	Significant (at 5%)	Observations
∆MRP predicts ∆Yield (5 year)	2.2987	0.1295	No	4,860
∆MRP predicts ∆Yield (10 year)	0.0002	0.9892	No	3,599
∆Yield predicts ∆MRP (5 year)	6.9745	0.0083	Yes	4,860
∆Yield predicts ∆MRP (10 year)	9.1912	0.0024	Yes	3,599

Source: Economic Regulation Authority's analysis

14. The null hypothesis (71) is rejected at the five percent level of significance for both the 5-year and 10-year series. This suggests that changes in the MRP do not have any predictive content with respect to changes in the Yield.

15. The null hypothesis (72) is not rejected at the five percent level of significance for both the 5-year and 10-year series. This suggests that changes in the Yield do contain predictive content with respect to changes in the MRP.

16. The same test was carried out directly on change in Return series (74) in place of the change in the MRP. The results are shown in Table 58.

Table 58 Granger Causality Test Results: Return and Yield Differenced Series – Lag 1

Test	F-Statistic	P-Value	Significant (at 5%)	Observations
∆Return predicts ∆Yield (5 year)	2.2987	0.1295	No	4,860
∆Return predicts ∆Yield (10 year)	0.0002	0.9892	No	3,599
∆Yield predicts ∆Return (5 year)	2.9669	0.085	No	4,860
∆Yield predicts ∆Return (10 year)	0.0223	0.8812	No	3,599

Source: Economic Regulation Authority's analysis

17. The tests of null hypothesis (71) are virtually identical when using the differenced return series - still suggesting that changes in the MRP do not have any predictive content with respect to changes in the Yield.

18. However, the test of hypothesis (72) rejects the null hypothesis that changes in the Yield do contain predictive content with respect to changes in the Return for both the 5 and 10 year series.

Conclusion

19. The Granger causality test suggests that changes in Australian Government bond yields Granger cause (as opposed to cause) changes in the market risk premium approximated by returns on the All Ordinaries Index less bond yields, but not vice versa.

20. Bond yields and market returns appear to contain no predictive content with respect to each other when a holding period approach (as discussed in Appendix 15) is taken to ensure market returns are matched with the yield to maturity holding period.

21. Tests to ensure the error terms are uncorrelated can be conducted as an additional test to ensure the results are robust.

Appendix 17 Econometric techniques adopted in the Authority's 2013 study to estimating equity beta

The Ordinary Least Squares

Introduction

1. The equity beta is typically estimated using ordinary least squares (**OLS**) where the sum of squared residuals are minimised to estimate the parameters α_i and β_i:

$$Min\sum_{t=1}^{T}\varepsilon_{i,t}^{2} = Min\sum_{t=1}^{T}(r_{i,t} - \hat{r}_{i,t})^{2} = Min\sum_{t=1}^{T}(r_{i,t} - \hat{\alpha}_{t} - \hat{\beta}_{t} r_{\mathrm{m},t})^{2} \quad (76)$$

where

$\hat{r}_{i,t}$, $\hat{\alpha}_i$ and $\hat{\beta}_i$ are OLS estimates of r_{it}, α_i and β_i.

Failure of OLS in financial data due to presence of outliers

2. Regression analysis involves fitting a model to observed data. The traditional linear model relates the dependent, or 'response', variable y_i to independent variables $x_{i1}, x_{i2}, ..., x_{ip}$ for $i = 1,...........n$ such that:

$$y_i = \beta_1 x_{i,1} + \beta_2 x_{i,2} + ... + \beta_p x_{i,p} + \varepsilon_i \quad (77)$$

where

$\beta_1, \beta_2, ..., \beta_p$ is the coefficients of the model[618]; and

ε_i is a random disturbance term.

3. Given a set of observed data, a regression estimator is chosen to estimate the unknown parameters $\beta_1, \beta_2, ..., \beta_p$, resulting in estimated values $\widehat{\beta}_1, \widehat{\beta}_2, ..., \widehat{\beta}_p$. From this fitted values of a response variable can be calculated as follows, $\widehat{y}_i = \widehat{\beta}_1 x_{i,1} + \widehat{\beta}_2 x_{i,2} + ... + \widehat{\beta}_p x_{i,p}$, which has the interpretation of been the predicted value produced by the estimated model, given observed values of the independent variables.

4. This model is commonly be expressed in matrix notation, expressing n observations of the k^{th} variable as $\mathbf{x_k}$, $k = 1, ..., p$, and assemble these data in an n x K data matrix, X . Let $\mathbf{y}$ be the n observations, $y_1, ..., y_n$ and let $\boldsymbol{\varepsilon}$ be the column vector containing the n disturbances. The entire model can now be represented in vector form as:

[618] It is generally assumed that $x_{i,1}$=1 for all i, so that β_1 corresponds to the intercept of the regression model.

$$\boldsymbol{y} = \boldsymbol{x}_1\beta_1 + \ldots + \boldsymbol{x}_{\boldsymbol{p}}\beta_p + \boldsymbol{\varepsilon} \tag{78}$$

5. Which can be expressed in matrix notation is:

$$\boldsymbol{y} = X\boldsymbol{\beta} + \boldsymbol{\varepsilon} \tag{79}$$

6. The most popular choice of regression estimator is the Ordinary Least Squares **(OLS)** estimator. In order to perform OLS, the following is assumed:[619]

- Full Rank: No exact linear relationship between any of the independent variables in the model.
- $E[\varepsilon_i \mid X] = 0$, which implies that the expected value of the disturbance at observation i is not a function of any of the independent variables in the sample
- Each disturbance has the same variance, $Var[\varepsilon_i] = \sigma^2$ and is independent of every other disturbance, $\varepsilon_i \perp \varepsilon_j$
- Each disturbance is a random variable following a normal distribution $\varepsilon_i \sim N(0, \sigma^2)$
- The least squares fit of a straight line consists of finding $\widehat{\beta_1}, \widehat{\beta_2}, \ldots, \widehat{\beta_p}$ such that the residuals,

$$r_i = y_i - (\widehat{\beta_1}x_{i,1} + \widehat{\beta_2}x_{i,2} + \ldots + \widehat{\beta_p}x_{i,p}) \tag{80}$$

Satisfy

$$Min(\sum_{i=1}^{n} r_i^2) \tag{81}$$

- In matrix notation, the OLS estimate satisfying the above is given by:

$$\beta_{LS} = (X'X)^{-1}X'y \tag{82}$$

7. If the observed data satisfies assumptions 1-4, it can be shown that OLS is the Best Linear Unbiased Estimator **(BLUE)**, implying that OLS is the best choice if these assumptions are met. That is, out of the class of linear and unbiased estimators, OLS has the lowest variance (and thus highest efficiency). It is generally understood that the assumptions (1 to 4) are an approximation for reality. In particular, the normality assumption holds only approximately in describing the majority of observed errors, particularly in an economics and financial context. A common reason for the failure of the normality assumption is a small proportion of errors being distinct from the rest of the errors. These observations are referred to as outliers and they can have a large influence on the estimator. Another failure of the normal assumption occurs if the distribution of errors has “heavier” tails than those of a normal distribution. Intuitively this can be understood as errors being large in magnitude, or more “extreme” than that predicted by the normal distribution.

[619] Greene, W.H. (2003). *Econometric analysis, 5th edition*. Upper Saddle River, NJ: Prentice Hall.

8. It is often assumed by practitioners that small departures from assumptions will not reduce the optimal properties of the OLS estimator. In particular, small deviations from assumptions I to IV will cause the OLS to be extremely sensitive to changes in the sample. Observations that are quite far from the majority of the data can dramatically affect the OLS estimate. For this reason, it is prudent to consider the use of other econometric techniques that estimate a linear trend in data. Robust statistical procedures are a reaction to the violation of assumptions used in traditional statistical analysis. Robustness can be described as 'insensitivity to small deviations from the assumptions made'.[620]

Least Absolute Deviations

9. It is well known that outliers can bias the estimates of equity beta. Australian regulatory practice indicates that the manual removal of such outliers is not appropriate because the removal may introduce subjectivity into the estimate of equity beta. With the presence of outliers, Henry's advice in 2009 was that the LAD method should be used to reduce the impact of outlier observations. The impact of outliers in the sample can be measure by comparing the estimates of equity beta from the OLS and the LAD methods. LAD regression minimises the sum of the absolute value (as opposed to the squared value) of the residuals. This regression can be expressed mathematically as follows:

$$Min\sum_{t=1}^{T}|\,\varepsilon_{i,t}\,| = Min\sum_{t=1}^{T}|\,r_{i,t}-\hat{r}_{i,t}\,| = Min\sum_{t=1}^{T}|\,r_{i,t}-\hat{\alpha}_t-\hat{\beta}_t r_{m,t}\,| \qquad (83)$$

where

- $\tilde{r}_{i,t,}$ $\tilde{\alpha}_i$ and $\tilde{\beta}_i$ are LAD estimates of r_{it}, α_i and β_i.

The MM methodology

Introduction

10. A central concept of robust statistics is the breakdown point of an estimator; the smallest fraction of contamination that can cause the estimator to "break down" and no longer represent the trend in the bulk of the data.[621] The breakdown point of the OLS estimator is 0%, as just one data point can cause the estimator to "break down".[622] Yohai (1987) defines the breakdown point as "The finite sample breakdown-point measures the maximum fraction of outliers which a given sample may contain without spoiling the estimate completely".[623] A trade-off between the breakdown point and statistical efficiency of a MM estimator exists - a higher breakdown point can be achieved by a reduction in statistical efficiency; or conversely, a higher statistical efficiency can result from a lower breakdown point.

11. The statistical efficiency of an estimator is defined as the ratio of its minimum possible variance to its actual variance. It is desirable for an estimator to have an efficiency ratio close to 1, as this ensures the estimator for the target parameter

[620] Huber, P.J. (1996). *Robust Statistical Procedures.* Second edition. Philadelphia: SIAM.

[621] Ibid.

[622] Yohai, V.J. (*1987*), High Breakdown-Point and High Efficiency Robust Estimates for Regression, *The Annals of Statistics, Vol.15, No.2.*

[623] Ibid.

has the lowest variance possible. Note that the concept of statistical efficiency assumes a normal distribution of the errors, which is likely to be invalid in situations where a robust estimator is required. It is however desirable for an estimator to have as higher breakdown point and statistical efficiency as possible. The MM estimator introduced by Yohai (1987)[624] has a breakdown point of 50 per cent, and a high statistical efficiency of 95 per cent.

The MM methodology

12. In order to understand MM regression, the concept of M and S regression must first be developed.

M Robust Regression

Recall that OLS minimises the following:

$$Min(\sum_{i=1}^{n} r_i^2) \tag{84}$$

where

$$r_i = y_i - (\widehat{\beta_1} x_{i,1} + \widehat{\beta_2} x_{i,2} + ... + \widehat{\beta_p} x_{i,p}) \tag{85}$$

13. Given that the residuals are a function of the estimated regression coefficients, $\widehat{\beta_1}, \widehat{\beta_2}, ..., \widehat{\beta_p}$, this can be expressed as:

$$Min(\sum_{i=1}^{n} r_i(\widehat{\boldsymbol{\beta}})^2) \tag{86}$$

14. By letting $\rho(x) = x^2$ this can be expressed as:

$$Min \sum_{i=1}^{n} \rho\,(r_i(\widehat{\boldsymbol{\beta}})) \tag{87}$$

15. M estimators generalise OLS by choosing a different function, ρ, which is a continuous, symmetric function with a minimum value at 0. The function is chosen that "down-weights" the larger residuals, as opposed to OLS, as $\rho(x) = x^2$ gives increasing weight to larger residuals. ρ is generally referred to as the objective function. The objective function is chosen through how the resulting estimator down-weights the larger residuals. Therefore, M robust regression can be seen as a form of "weighted regression", with the weights determined by the objective function and the size of the residuals, r_i. In general, the objective function is chosen in order to assign less weight to outlying observations, as opposed to OLS which assigns increasing weight.[625]

[624] Yohai, V.J. (*1987*), High Breakdown-Point and High Efficiency Robust Estimates for Regression, *The Annals of Statistics, Vol.15, No.2.*

[625] Maronna, R.; D. Martin and V. Yohai (2006). *Robust Statistics: Theory and Methods*. Wiley. p. 28.

16. Before proceeding with the above, M-estimators require an adjustment to take into account that the above will not be *scale equivalent.*[626] This problem is solved by standardising the residuals in (87) by an estimate of their scale, s. M-estimators therefore minimise the following:

$$Min\sum_{i=1}^{n}\rho\left(\frac{r_i(\widehat{\beta})}{\widehat{\sigma}}\right) \tag{88}$$

17. Note that OLS does not require this adjustment in (87), as for OLS:

$$Min\sum_{i=1}^{n}\rho\left(\frac{r_i(\widehat{\beta})}{\widehat{\sigma}}\right)=Min\sum_{i=1}^{n}\left(\frac{r_i(\widehat{\beta})}{\widehat{\sigma}}\right)^2=\frac{Min\sum_{i=1}^{n}\left(r_i(\widehat{\beta})\right)^2}{\widehat{\sigma}^2} \tag{89}$$

18. Therefore, OLS does not require a scale adjustment as minimising (86) is equivalent to minimising (89). Given that the objective function is generally piecewise[627], this is not the case for M robust regression. The most popular choice for estimating $\widehat{\sigma}$ is the "*rescaled MAD*" (median absolute deviation) estimate, where:[628]

$$\widehat{\sigma}=1.4826\times\text{MAD} \tag{90}$$

where

$$\text{MAD}=\text{median}|r_i|$$

19. In order to minimise equation (88), the partial derivatives with respect to the parameters are calculated and set to 0 as follows:

$$\begin{aligned}&\frac{\partial}{\partial\beta_i}\sum_{i=1}^{n}\rho\left(\frac{r_i(\widehat{\beta})}{\widehat{\sigma}}\right)=0\\&-\frac{1}{\widehat{\sigma}}\sum_{i=1}^{n}x_i*\rho'\left(\frac{r_i(\widehat{\beta})}{\widehat{\sigma}}\right)=0\\&\sum_{i=1}^{n}x_i*\psi\left(\frac{r_i(\widehat{\beta})}{\widehat{\sigma}}\right)=0\end{aligned} \tag{91}$$

where

$\psi(u)=\frac{\partial\rho}{\partial u}$ is referred to as the "score function".

20. Equation (90) does not have a closed form solution, therefore algorithms which employ iterative solutions are used to estimate the required parameters, $\widehat{\beta}_1,\widehat{\beta}_2,...,\widehat{\beta}_p$.

[626] The scale parameter measures the statistical dispersion of a probability distribution, ie for the Normal distribution $N(\mu,\sigma^2)$ the scale parameter is σ.

[627] A function that is made up of different sub-functions, each sub function defined over different domains.

[628] Andersen, R. (2008). *Modern Methods For Robust Regression.* Thousand Oakes: SAGE Publications.

21. M-estimators are highly efficient; being 95% as efficient as OLS when the assumptions of OLS are achieved. In situations where there is a heavy-tailed error distribution and non-constant error variance, M estimators are *more* efficient than OLS. [629] M estimators are generally not employed as robust regression estimators in practice due to their lack of robustness to leverage points[630]. Therefore, in this situation M estimators have a breakdown point of 0%. They however provide an important starting point to other forms of more resistant regression.

S-Estimator regression

22. S-estimators are a reaction to the vulnerability of M estimators. S estimators seek to minimise a measure of the dispersion of the residuals. The dispersion of the residuals, s, is defined as the solution to the following:

$$\frac{1}{n}\sum_{i=1}^{n}\rho\left(\frac{r_i(\widehat{\beta})}{s}\right)=K \tag{92}$$

where

K is a constant, and the objective function ρ satisfies the following conditions:

1) ρ *is symmetric and continuously differentiable, and* $\rho(0)=0$

2) $\exists a$ s.t ρ is strictly increasing on [0,a] and constant on $[a,\infty)$

3) $\frac{K}{\rho(a)}=\frac{1}{2}$

23. An S-estimator is therefore defined as the parameters, $\widehat{\beta_1},\widehat{\beta_2},...,\widehat{\beta_p}$ that results in the *s* defined in (92) as being minimal. Formally, *s* is a function of the residuals, $r_i(\widehat{\beta})$ and therefore s is chosen as follows:

$$\arg\min_{\beta} s(r_1(\widehat{\beta}),r_2(\widehat{\beta}),...,r_n(\widehat{\beta})) \tag{93}$$

24. If conditions (1-3) are satisfied, the S-estimator has a breakdown point of 50 per cent. Unfortunately, S-estimators suffer from low statistical efficiency. It is for this reason that S-estimators are not used in practice as a robust regression estimator.

MM-Estimator

25. MM estimators are designed to have a simultaneously high breakdown point and high statistical efficiency. The MM-estimator is computed in 3 stages, combining elements of both the M-estimator and S-estimator:[631]

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629 Ibid.

630 A leverage point is an outlier in one of the explanatory variables, $x_{i1},x_{i2},...,x_{ip}$ as opposed to response variable, y_i.

631 Yohai, V.J. (*1987*), High Breakdown-Point and High Efficiency Robust Estimates for Regression, *The Annals of Statistics, Vol.15, No.2.*

Stage 1:
An initial estimate of β is calculated, using the S-estimator (Equation 93), denoted as $\tilde{\beta}$. Using this estimator, a set of residuals is calculated as:

$$r_i(\tilde{\beta}) = y_i - (\tilde{\beta}_1 x_{i,1} + \tilde{\beta}_2 x_{i,2} + ... + \tilde{\beta}_p x_{i,p}) \quad (94)$$

Stage 2:
Using these residuals, an "M-estimate of scale" is calculated using (92) as follows:

$$\frac{1}{n}\sum_{i=1}^{n} \rho_0\left(\frac{r_i(\tilde{\beta})}{s_n}\right) = K \quad (95)$$

Therefore,

$$s_n = s(r_1(\tilde{\beta}), r_2(\tilde{\beta}), ..., r_n(\tilde{\beta})) \quad (96)$$

Stage 3:
An M estimator (equation 88) is than calculated using s_n as the estimate of scale.

$$\underset{\beta}{Min}\sum_{i=1}^{n} \rho_1\left(\frac{r_i(\hat{\beta})}{s_n}\right) \quad (97)$$

The objective function, ρ_1 must satisfy the following constraints:

- ρ_1 is symmetric and continuously differentiable, $\rho_1(0)=0$.
- $\exists a$ s.t ρ is strictly increasing on [0,a] and constant on [a,∞)
- $\rho_1(u) \le \rho_0(u)$
- $\sum_{i=1}^{n} \rho_1\left(\frac{r_i(\hat{\beta})}{s_n}\right) \le \sum_{i=1}^{n} \rho_1\left(\frac{r_i(\tilde{\beta})}{s_n}\right)$

$\hat{\beta}$ is the MM estimator. Given that the MM estimator has no closed form, an iterative solution to $\hat{\beta}$ is calculated using the following:

$$\sum_{i=1}^{n} x_{i,j}\psi_1\left(\frac{r_i(\hat{\beta})}{s_n}\right) = 0 \qquad j=1,........p \quad (98)$$

where

$$\psi_1(u) = \frac{\partial \rho_1(u)}{\partial u}.$$

26. In practice, the objective functions used for ρ_0 and ρ_1 is the Tukey bisquare objective function.[632] The R software package implements this as its standard choice for MM regression. In this circumstance, the MM estimator will have a breakdown point of 50%, and a relative statistical efficiency of 95 per cent. Given the high breakdown point and high statistical efficiency of MM regression, it offers the best choice for robust regression currently available.

27. It is noted by Maronna and Yohai (2010)[633] that the theoretical properties of the MM estimator are based on asymptotic distributions and large sample theory. As a consequence, the practical performance of an MM estimator may be inferior to its theoretical properties for small samples.

The Theil-Sen methodology

28. The Theil-Sen Estimator is an alternative robust, nonparametric estimator proposed by Theil (1950) and Sen (1968). The Theil-Sen estimator is only applicable in univariate regression, i.e regression of the form: $y_i = \alpha + \beta x_{i,1}$. For each pair of possible points in a data sample, the slope is calculated and then ranked. The Theil-Sen estimator of the slope is than calculated as the *median* of these slopes. Formally this can be expressed as:

$$\beta_{TS} = median\{\beta_{ij}\}$$

$$\beta_{TS} = median\{\beta_{ij} \mid \beta_{ij} = \frac{y_j - y_i}{x_j - x_i}, x_i \neq x_j, 1 \leq i < j \leq n\} \qquad (99)$$

where

β_{ij} is the slope between point i and point j; and

$\alpha_{TS} = median\{y_i - \beta_{TS} \times x_i\}$.

29. It is noted by Sen(1968)[634] that the OLS estimator, can itself be expressed as a linear function of the slopes between two points. Sen states that the OLS estimator can be expressed as follows:

$$\beta_{OLS} = \sum_{i=1}^{n}\sum_{j=1}^{n}(x_j - x_i)^2 \beta_{i,j} \qquad (100)$$

30. Given that OLS is thus just a weighted average of $\beta_{i,j}$, the slope between each possible point, it follows that both the Theil-Sen estimator and OLS are both functions of $\beta_{i,j}$. Therefore as the median is more robust to outliers than a

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[632] The Tukey Bi-square function is defined as : $\rho(u) = \begin{cases} \frac{u^2}{2} - \frac{u^4}{2a^2} + \frac{u^6}{6a^4} & \text{if } |u| \leq a \\ \frac{a^2}{6} & \text{if } |u| > a \end{cases}$

[633] Maronna, R. A. And V.J Yohai (2010). 'Correcting MM estimates for "fat" data sets.' *Computational Statistics and Data Analysis,* Vol.54, No. 12, pp. 3168-3173.

[634] Sen, P.K (1968). 'Estimates of the Regression Coefficient Based on Kendall's Tau.' *Journal of the American Statistical Association,* Vol.63, No. 324 pp. 1379-1389.

weighted average, it follows that the Theil-Sen estimate is more robust to outliers than the OLS estimator.

31. The Theil-Sen estimator is an unbiased, scale equivalent estimator of the true parameter to be estimated, β.[635] The Theil-Sen estimator has a breakdown point of 29%,[636] which holds even for relatively small samples. In addition, the regression is valid even when both the dependent and independent variable are random variables (as is the case in a financial context), unlike OLS.[637] In addition, the Theil-Sen estimator has a high statistical efficiency, implying that OLS offers only a slight advantage in circumstances where the errors are normally distributed. It has been shown that in the presence of heteroscedasticity, the Theil Sen estimator gives far more accurate results than OLS.[638]

32. Given the predominance of outliers in financial data, it is generally surprising that the Theil-Sen estimator is not more widely used in estimating the beta coefficient.[639] The lack of popularity of the Theil-Sen estimator may be explained by the computational power needed in order to calculate it. Given a dataset of size n, the Theil-Sen estimator requires $\frac{(N)(N-1)}{2}$ different slopes to be calculated. Therefore, before the advent of high computing power, the Theil-Sen estimator was beyond the reach of practitioners.

[635] Ibid.

[636] Wilcox, R.R (2001) *Fundamentals of Modern Statistical Methods.* Springer.

[637] Sen, P.K (1968). 'Estimates of the Regression Coefficient Based on Kendall's Tau.' *Journal of the American Statistical Association,* Vol.63, No. 324 pp. 1379-1389.

[638] Ibid.

[639] Fabozzi, F.J(2013) *Encyclopedia of Financial Models,* Wiley Publications.

Appendix 18 Descriptions of companies in the equity beta sample

Ticker	Industry Sector	Company Description (as at April 2013)
ENV AU Equity	Utilities	Envestra Limited operates natural gas distribution networks and transmission pipelines in South Australia, Queensland and the Northern Territory. The Company's networks distribute gas to households and businesses in Adelaide, Brisbane (north of Brisbane River), Alice Springs and various regional centers in South Australia and Queensland.
APA AU Equity	Energy	APA Group is a natural gas infrastructure company. The Company owns and or operates gas transmission and distribution assets whose pipelines span every state and territory in mainland Australia. APA Group also holds minority interests in energy infrastructure enterprises.
DUE AU Equity	Utilities	DUET Group invests in energy utility assets located in Australia and New Zealand. The Group's investment assets include gas pipelines and electricity distribution networks.
HDF AU Equity	Financial	Hastings Diversified Utilities Fund invests in utility infrastructure assets such as gas transmission and distribution assets, electricity generation, transmission and distribution assets, hydro and wind power generation assets and regulated and unregulated assets.
SPN AU Equity	Utilities	SP Ausnet owns and operates electricity transmission and electricity and gas distribution assets in Victoria, Australia.
SKI AU Equity	Utilities	Spark Infrastructure Group invests in utility infrastructure assets in Australia.

Source: Bloomberg

Appendix 19 Adjustments to Bloomberg's reporting of data

1. The Bloomberg terminal offers the ability to adjust reported stock prices for events such as stock splits, dividend to keep prices movements comparable to the historical series. For example, if a two-for-one stock split occurs, a share in a particular company that was values $50, holding all other factors, constant is now valued at $25. To maintain comparability to the past data, an adjustment can be made.

2. In the data set used historical pricing, adjustments were made to reflect company equity policy such as spin-offs, stock splits/consolidations, stock dividend/bonus, rights offerings/entitlement. Similarly, the price may drop as a result of dividend payouts which take many forms.

3. The last price was adjusted for change on day for all normal and abnormal cash dividend types except omitted, discontinued, deferred or cancelled.

4. Normal dividend adjustments included those dividends made for regular cash, interim, first interim, second interim, third interim, fourth interim, income, estimated partnership distribution, interest on capital, distribution and prorated dividends.

5. Abnormal dividend adjustments were made for special cash, liquidation, capital gains, long-term capital gains, short-term capital gains, memorial, return of capital, rights redemption, miscellaneous, return premium, preferred rights redemption, proceeds/rights, proceeds/shares and proceeds/warrants.

6. Bloomberg offers the ability to make adjustments for changes in volume, however no such adjustments were made to the series used in this analysis.

Appendix 20 De-levering and Re-levering factors

1. Since the sample used in this analysis consists of many utilities with differing gearing levels, a de-levered/re-levered factor is needed. The average level of gearing $\bar{G}$ is calculated as the average level of the book value of net debt $\bar{D}$ as a proportion of the value of the firm represented by the sum of the book value of net debt $\bar{D}$ and market value of equity $\bar{E}$. The average gearing level can be presented in equation (101) below:

$$\bar{G} = \frac{\bar{D}}{\bar{D} + \bar{E}} \tag{101}$$

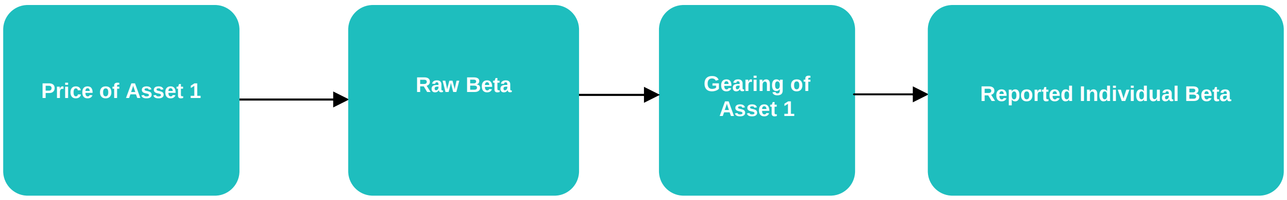
2. Australian economic regulators have assumed the benchmark gearing level of 60 per cent debt and 40 per cent equity in their regulatory decisions.[640] As such, the conventional approach to calculate the re-levering factor, which will be applied to raw beta estimates from the regression, is calculated using:

$$\omega = \frac{1 - \bar{G}}{1 - 0.6} \tag{102}$$

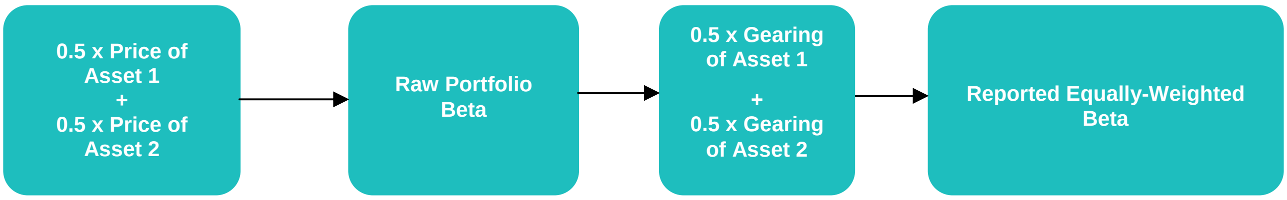
[640] Australian Energy Regulator (2008), "Explanatory Statement: Electricity transmission and distribution network service providers Review of the weighted average cost of capital (WACC) parameters" p.14.

Appendix 21 Constructions of the equally-weighted portfolios and the value-weighted portfolios

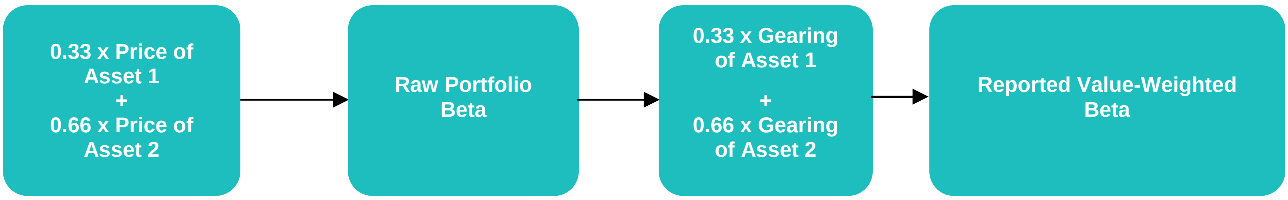
Individual Equity Betas



Equal Weighted Portfolio Equity Betas



Value Weighted Portfolio Equity Betas



1. The above diagrams give a stylised explanation of the differences between the individual, equal weighted and value weighted portfolio betas.

2. The individual's raw equity betas are estimated based on the individual equity's price. The gearing for the company in question is then applied to the raw beta through a 'de-levering/re-levering formula' to create the equity beta that is reported in this study.

3. The equal weighted portfolio raw equity betas are estimated based on an equally weighted price of each individual equity, for example if there are two equity each will receive a weight of 50 per cent, three equities, a weight of 33.33 per cent and so on. The gearing for the company is then calculated as an equally weighted average using the same weighting and then applied to the raw portfolio beta through a 'de-levering/re-levering formula' to create the reported equity beta.

4. The value weighted portfolio raw equity betas are similar, but instead based on weights reflecting their relative market capitalisation within the portfolio. If the total market capitalisation was $1b with asset one's capitalisation equal to $333.33m and assets two's capitalisation equal to $666.66m the first asset will receive a weight of 0.33 while the second a weight of 0.66. The gearing for the company is then calculated as a weighted average using this same weighting and then

applied to the raw portfolio beta (again through a ‘de-levering/re-levering formula’) to create the reported equity beta.

Appendix 22 Empirical evidence on debt raising costs

1. There are a number of estimates of debt raising costs for regulatory purposes in Australia, these include: (i) the ACCC's 2004 estimate; (ii) the ACG's 2004 estimate for the ACCC; (iii) Deloitte's 2010 estimate for Envestra; and (iv) PricewaterhouseCoopers' 2011 estimates. In addition, based on the ACG's 2004 approach, the AER has also updated its own estimates of the debt raising costs in its regulatory decisions.

ACCC's 2004 estimate

2. The Australian Competition and Consumer Commission (**ACCC**) determined an initial allowance of 10.5 to 12.5 bppa for debt raising costs for regulated utilities in 2002 and 2003. These estimated figures were based on its own research.[641] The ACCC decisions are regarded as the decisions that led the way for other Australian regulators to use 12.5 bppa in their estimates of debt raising costs. The ACCC estimate is comprised of specific financing fees detailed in Table 59.

Table 59 The Australian Competition and Consumer Commission's Debt Raising Cost Estimate in 2004 (basis points per year)

Non-margin financing fee	Allowance (bppa)
Arranger fee	0.4
Agency fee	0.3
Placement fee	5.0
Gross underwriting fees	**5.7**
Company credit rating fees	1.2
Legal fees	0.6
Total before swap margin	**7.5**
Dealer swap margin	5.0
Total	**12.5**

Source: Australian Competition and Consumer Commission, 2002, Final Decision: GasNet access arrangement revisions for the Principal Transmission System, p.147.

ACG's 2004 report

3. In 2004, the ACCC engaged the Allen Consulting Group (**ACG**) to further examine and determine an accurate allowance for debt raising costs. The ACG undertook data analysis,[642] interviews with market participants and a literature review to determine an appropriate allowance. In this study, ACG estimated debt raising costs to be between 8.0 and 10.4 bppa.[643]

[641] Australian Competition and Consumer Commission, 2002, Final Decision: GasNet access arrangement revisions for the Principal Transmission System, p.95.

[642] Data sources included Bloomberg, Basis Point, Prospectuses for IPOs and SEOs and Osbourne Associates survey of funding program fee charges.

[643] The variance in basis points per annum results from the number of issues per annum. The company credit rating fee can be divided amongst the number of issues per annum, which results in a lower overall debt raising cost fee per issue.

4. In its report, ACG outlined criteria for which fees are included or excluded in its analysis of debt raising costs for bonds. ACG first considered "Discretionary fees" that are associated with domestic corporate bond issues. ACG argued that as these outlays are optional, they should not be a part of the regulated allowance for debt issuance.

5. The first discretionary fee is that associated with interest and currency swaps. Given that an initial offering of a floating rate bond is subject to both currency and interest rate risk, firms can hedge this risk by entering into a swap contract. As costs arising from interest rate swaps are optional, giving the firm the opportunity to eliminate interest rate risk, ACG does not consider it necessary to include it in the cost of debt allowance.

6. The second discretionary fee relates to "Credit Wrapping", the provision of a financial guarantee to the obligations made by the issuer of the bond. As credit wrapping allows a regulated entity to achieve a higher credit rating, the benefits from credit wrapping offsets the fees for credit wrapping. Therefore as credit wrapping fees are optional, they are not included in the cost of debt allowance.

7. In addition, advisory fees refer to "fees payable to a financial adviser when arranging debt". As advisory fees are optional, ACG does not consider it necessary to include in the cost of debt allowance.

8. ACG then outlined the fee structure that is relevant for the cost of debt allowance. This structure includes various types of fees which are discussed below:

   - the management fee refers to the fee related to the arrangement on the entire bond issuance process on behalf of the client. Typically, this fee is paid to the lead arranger to act as a contact between the bond issuer and potential bond purchasers. If the bond issuance is not sold, the underwriter will take up the issuance, guaranteeing the proceeds of the issuer. As such, an underwriting fee is therefore required to the payment to the underwriter of a bond issue for taking on risk.
   - the Selling (Placement or Agent) fee refers to the fee provided to the selling agent for selling an issue to their client bases.
   - the legal costs of a debt issuance refer to the legal documentation required in a bond issuance.
   - a credit rating fee is required in order to obtain a credit rating for bond issuance. The credit rating fee is paid on an upfront basis in order to obtaining an initial credit rating, and a per annum charge subsequently.

9. In order to estimate the debt issuance cost for a benchmark entity, ACG applied the following methodology:

Step 1: Data Set selected

The sample includes all Australian companies (excluding banks and GBE's) issuing bonds (excluding convertible bonds) with gross underwriting fees reported by Bloomberg.

Step 2: Group the bond issues by tenor and calculate basis points per annum (bppa)

Bond issues are grouped into 5- and 10-year maturities, in order to assess the influence of maturity on gross underwriting fees. The Bppa is then calculated by dividing the total gross fees by maturity.

Step 3: Adjust the bppa for 5 to 10 year maturity

The median tenor of international bond issues by Australian companies is calculated on a rolling 5-year basis.

Step 4: Calculate the median rolling 5 year bppa gross underwriting fee for each maturity group

The median rolling 5 year gross underwriting fee is calculated for each maturity group on the basis of the adjusted bppa fees (Step 3).

Step 5: Calculate the median maturity and issue size of bonds issued by Australian infrastructure companies in the domestic market

Step 6: Adjust the median gross underwriting cost (bppa) to the appropriate tenor assumption

The median gross underwriting fee is calculated by interpolation from the medians of both the 5 and 10 year maturity underwriting fees.

Step 7: Assess legal and ancillary costs

This is done via consultation with industry sources such as investment banks, lawyers and Standard and Poors.

Step 8: Calculate the number of issues required

To refinance all the bonds in the utility's capital structure the number of issues need to be determined. This is calculated by dividing the required debt amount by the standard assumed issue size.

Step 9: Calculate the total debt issuance transaction cost in bppa

10. Based on a given maturity assumption, divided by the total debt raised, multiplied by 10,000 yields the total debt issuance cost in bppa.

11. ACG's resulting estimated allowance for debt raising cost is comprised of specific financing fees as shown in Table 60.

Table 60 Allen Consulting Group's Debt Raising Cost Estimate (bppa), 2004

Fee	Explanation/Source	1 Issue	6 Issues
Amount Raised	Multiples of median MTN issue size	$175m	$1,050m
Gross Underwriting Fees	Bloomberg for Australian international issues	5.50	5.50
Legal and Roadshow	$75k-$100k: Industry sources	1.14	1.14
Company Credit Rating	$30k-$50k: S&P Ratings	2.86	0.48
Issue credit rating	3.5 bps up-front: S&P Ratings	0.70	0.70
Registry fees	3K per issue, Osborne Associates	0.17	0.17
Paying fees	$1/$1m quarterly, Osborne Associates	0.01	0.01
Totals	**Basis points p.a.**	**10.4**	**8.0**

Source: Allen Consulting Group, December 2004, Debt and Equity raising transaction costs: Final report to ACCC pp. xvii.

12. The Authority notes that the fundamental difference between the ACCC's and ACG's allowance of debt raising cost relates to the swap margin fee.[644] The ACCC included the swap margin in its estimate of the debt raising costs, whereas the ACG took the view that the swap margin should be included in the debt risk premium rather than in debt raising costs. ACG's conclusion was based on three of the four major Australian banks indicating that a swap margin should not be included in the debt raising costs.[645]

Deloitte's 2010 study

13. In 2010, Envestra Limited engaged Deloitte to provide empirical evidence on debt raising costs for a medium term note and a syndicate bank debt issue.[646][647] Envestra requested that Deloitte provide estimates for the benchmark efficient service provider accessing two types of debt funding: (i) domestic bonds (Medium Term Notes, **MTN**) and (ii) syndicated bank debt.

14. Deloitte considered the MTNs incurred the same fee types as previously determined by ACG in its 2004 report for the ACCC. However, Deloitte was of the view that the issuance of syndicated bank debt incurred the following fees:[648]

    - *Upfront/Establishment fees*: if the issuance is not underwritten, this includes due diligence and financial modelling, leading syndicate and contact. However, if the issuance is underwritten, the fee is for guarantee of issue proceeds to the issuer.

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644 A credit swap margin reflects the cost of converting floating rate debt into fixed rate debt as defined in the Allen Consulting Group, 2004, *Debt and Equity raising transaction costs: Final report to ACCC*, pp. xx.

645 Allen Consulting Group, 2004, *Debt and Equity raising transaction costs: Final report to ACCC*, pp. xvii.

646 Deloitte, 2011, *Envestra Limited- Debt Financing Costs,* page 3

647 MTN are issued by a domestic issuer for a 5 year tenor, whereas DRP is measured on the basis of a 10 year tenor. Deloitte, 2011, *Envestra Limited- Debt Financing Costs,* Pg. 5

648 Deloitte, 2011, *Envestra Limited- Debt Financing Costs,* Pg. 3 and page 11

- *Credit margin*: payable over the applicable Commonwealth Government yield for 3 year and 5 year maturities.
- *Commitment fees*: this fee is calculated on any unused portion of the credit limit that participating banks have committed to provide.
- *Security fees*: this fee deals with the security trustee function.
- *Legal and agency fees:* these fees are defined in the same manner as ACG's definition in its 2004 estimate.

15. Fees were estimated by Deloitte from the domestic-institutional market[649] and the domestic-retail market.[650] These fees are presented in Table 61 below.

Table 61 Deloitte' Estimate of Debt Raising Cost in 2010

	Minimum Domestic-Institutional	Maximum Domestic-Institutional	Minimum Domestic-Retail	Maximum Domestic-Retail
Arranger (bp)	40	50	100	120
Structuring (bp)	-	-	30	30
Selling (bp)	-	-	100	175
Rating Agency (bppa)	5	5	-	-
Legal ($)	40,000	55,000	300,000	300,000
Registry ($ pa)	10,000	15,000	60,000	60,000

Source: Deloitte, 2011, Envestra Limited - Debt Financing Costs, *p. 9.*

16. In its report, Deloitte indicated that a unit rate of 10.1 bppa was appropriate for standard debt raising costs. In addition, Deloitte included an additional allowance of 10.2 bppa to cover bridging finance. Deloitte argued that bridging finance is required so that companies with an investment grade credit rating can meet the refinancing requirements of Standard and Poor's. As such, a total debt raising cost unit rate of 20.3 bppa was estimated.

17. In its decision in February 2011, the AER rejected the validity of Deloitte report in terms of the estimated debt raising costs and bridging finance costs. The AER was of the view that Deloitte's report in 2010:[651]

- made no allowance for multiple bond issues;
- did not adjust for the time value of money;
- used the median bond issue size from 2004 ($175 million), instead of the more up to date estimates of $250 million;
- used BBB+ rated bonds only; and
- was not transparent with regard to many key data attributes

649 The domestic institutional market requires the issuer to have an investment grade (S&P) credit rating with transaction of $175m executed by two banks.

650 The domestic retail market comprises of portfolios of individual investors that are managed by independent financial planners or financial planning/advisory arms of banks, insurers and wealth managers. Deloitte, 2011, *Envestra Limited- Debt Financing Costs,* page 8.

651 Australian Energy Regulator, 2011, *Envestra Limited: Access Arrangement Proposal for the South Australia Gas Network,* February 2011, pp. 317-8.

PricewaterhouseCoopers's 2011 report

18. A more recent estimate of the debt raising cost was conducted by PricewaterhouseCoopers in its 2011 report for Powerlink. The findings from the PricewaterhouseCoopers report indicate that the allowance of debt raising costs should fall within the range of 9.1 bppa (for 16 issues) and 9.7 bppa (for a standard-size issue of A$250 million). The findings from this report are presented in Table 62 below.

Table 62 PricewaterhouseCoopers' Estimate of Debt Raising Cost in 2011 (bppa)

Fee	PricewaterhouseCoopers (2011)	
	1 Issue	16 Issues
Amount Raised	$250m	$4,000m
Gross Underwriting Fees	7.2	7.2
Legal and Roadshow	1.16	1.16
Company Credit Rating	0.63	0.04
Issue credit rating	0.67	0.67
Registry and Paying fees	0.06	0.06
Totals (bppa)	**9.7**	**9.1**

Source: PricewaterhouseCoopers, Appendix K Debt and Equity Raising Costs, *Report for Powerlink Queensland, 2011, pp.19.*

The Australian Energy Regulator's estimate

19. The AER has estimated the debt raising costs in its regulatory decisions based on the approach adopted in the ACG's 2004 report to the ACCC. In its most recent regulatory decision on the debt raising costs for APA GasNet in March 2013, the AER's estimates of debt raising costs were between 9.4 and 10.8 bppa (with a nominal WACC of 7.22 per cent). The estimates are presented in Table 63 below.

Table 63 AER's Debt Raising Cost Estimate (bppa), 2013

Fee	Explanation/Source	1 Issue	2 Issues	3 Issues
Amount Raised	Multiples of median MTN issue size ($250m)	$250m	$500m	$750m
Gross Underwriting Fees	Bloomberg for Australian international issues, upfront per issue, amortised	6.47	6.47	6.47
Legal and Roadshow	$195K upfront per issue, amortised	1.12	1.12	1.12
Company Credit Rating	$55K for the entire company, per year	2.20	1.10	0.73
Issue credit rating	4.5 bps up-front per issue, amortised	0.65	0.65	0.65
Registry fees	$4K upfront per issue, amortised	0.02	0.02	0.02
Paying fees	$9K per issue per year	0.36	0.36	0.36
Totals	**Basis points p.a.**	**10.8**	**9.7**	**9.4**

Source: AER, March 2013, Final Decision, Access Arrangement APA GasNet Australia, Table 7.6, page 137.

20. In the past three years, the AER's estimates of debt raising costs have consistently been around 10 bppa. It is noted that the AER has amortised the fees over 10 years.

Other recent data from company's prospectuses

21. The Authority conducted its own market research to estimate current debt raising costs in Australia. The approach taken by the Authority was to estimate the costs of the individual components of debt raising fees, as contained in Table 63, which were adopted in the ACG's 2004 estimate.

22. In undertaking its research, the Authority found that very few companies included debt raising costs in their prospectuses. Moreover, for prospectuses in which debt raising cost data was available it is usually presented as an aggregated figure with limited or no information in relation to the components. As such, the Authority was unable to identify relevant components of debt raising costs.

23. Table 64 presents three examples of recent debt raising cost data for which a number of components of the total cost figure are unavailable.

Table 64 Debt Raising Costs from Company's Prospectus

Fee	AMP	APA	Caltex
Amount Raised	$300m	$350m	$525m
Gross Underwriting Fees	0.6	0.75	2.67
Legal and Roadshow	0.20	0.40	0.11
Company Credit Rating	N/D	N/D	N/D
Issue credit rating	N/D	N/D	N/D
Registry fees	N/D	N/D	N/D
Paying fees	N/D	N/D	N/D
Other (not specified)	2.03	2.42	0.08
Totals (%)	**2.83**	**3.57**	**2.86**

Source: *AMP Group Financial Services, AMP Notes Prospectus, 2009, accessed from Bloomberg. APA Group, APA Group Subordinated Notes, 2012, accessed from Bloomberg. Caltex Australia Limited, Prospectus Caltex Subordinated Notes, 2012, accessed from Bloomberg. N/D shows that the data was not disclosed.*

24. The percentage of the total debt raising cost is calculated as a ratio between stated expenses in relation to the issuance of debt and the total amount at issuance. The total expenses do not provide any specific estimates of cost components. As such, they are not relevant for comparison purposes with other estimates presented previously.

The Authority's estimate of debt raising costs in 2013

25. As an illustration, the Authority has conducted its own estimate of the debt raising cost for the purpose of this rate of return guidelines. In this estimate, the approach used in the ACG 2004 report is adopted. In addition, data in relation to legal and road show fees; company credit rating fee; issue credit rating; registry fee; and paying fee are sourced from the AER's final decision on APA GasNet access arrangement, released in May 2013. The Authority understands that the inputs used by the AER were based on estimates provided to the AER by credit rating agencies and investment bankers.

26. As presented in Table 65, depending on the number of issues, debt raising costs range from 11.8 bppa to 13.8 bppa. However, these estimates will vary depending on some key assumptions. It is noted that all costs are amortised over 5 years.

27. First, the range of estimates is based on an assumed vanilla WACC of 6 per cent. The WACC is determined individually for each regulatory decision. The Authority notes that, assuming that all other inputs remain unchanged, a lower WACC estimate will lead to a lower range of estimates of debt raising costs.

28. Second, as indicated in the ACG 2004 estimate, the gross underwriting fee is derived from a sample of Australian bonds issued in the international markets. The criteria for including bonds in a sample are set out in the ACG's 2004 report. As the sample changes, the value of the gross underwriting fee changes.

29. As presented in Table 21, depending on the number of issues, debt raising costs range from 11.8 bppa to 13.8 bppa. However, these estimates will vary

depending on some key assumptions. It is noted that all costs are amortised over 5 years.

Table 65 The Authority's estimate of debt raising costs (bppa), 2013

Fee	Explanation/Source	1 Issue	2 Issues	4 Issues	6 Issues	10 Issues
Total Amount Raised	Multiples of median MTN issue size ($250m)	$250m	$500m	$1,000m	$1,500m	$2,500m
Gross Underwriting Fees	Bloomberg for Australian international issues, upfront per issue, amortised	8.31	8.31	8.31	8.31	8.31
Legal and Road show	$195K upfront per issue, amortised	1.85	1.85	1.85	1.85	1.85
Company Credit Rating	$55K for the entire company, per year	2.20	1.10	0.55	0.37	0.22
Issue credit rating	4.5 bps up-front per issue, amortised	1.07	1.07	1.07	1.07	1.07
Registry fees	$4K upfront per issue, amortised	0.04	0.04	0.04	0.04	0.04
Paying fees	$9K per issue per year	0.36	0.36	0.36	0.36	0.36
Totals	**Basis points p.a.**	**13.8**	**12.7**	**12.2**	**12.0**	**11.8**

Source: ACG; Bloomberg; AER; and the Economic Regulation Authority's analysis

30. First, the range of estimates is based on an assumed vanilla WACC of 6 per cent. The WACC is determined individually for each regulatory decision. The Authority notes that, assuming that all other inputs remain unchanged, a lower WACC estimate will lead to a lower range of estimates of debt raising costs.

31. Second, as indicated in the ACG 2004 estimate, the gross underwriting fee is derived from a sample of Australian bonds issued in the international markets. The criteria for including bonds in a sample are set out in the ACG's 2004 report. As the sample changes, the value of the gross underwriting fee changes.

32. Third, a change in any other input will result in a change in the estimate of debt raising costs.

33. Table 65 above presents a hypothetical example assuming that a regulated business has a regulatory asset value (RAB) of A$3,200 million. Given the assumed gearing of 60 per cent, the amount of debt to be raised or refinanced is A$1,920 million, which requires approximately 8 standard-size issues. In this hypothetical example, the allowance for debt raising costs would be approximately 12 bppa, being in a range of 11.8 bppa for 10 issues and 12 bppa for 6 issues.

Appendix 23 Derivation of Gamma using Officer's WACC framework

1. The theoretical framework for examining how franking credits alter the Weighted Average Cost of Capital (WACC) was proposed by Officer (1994).[652] By considering the Earnings Before Interest and Tax (EBIT) of a company, and how it is distributed between the government (Taxation), debt holders and equity holders the firms before tax WACC can be derived. A firms EBIT is distributed as follows:

$$X_O = X_G + X_D + X_E \qquad (103)$$

where:

X_O is operating income

X_G is the government's share of operating income (taxation),

X_D is the debt holders share of operating income, and

X_E is the equity holders share of operating income

2. Under an imputation tax system, companies "pre-collect" personal income tax for governments when they pay company tax. The proportion of the tax collected from the company which will be rebated against personal tax is defined as gamma. It is convenient to consider gamma as the proportion of personal income tax collected at the company level. As a consequence, the effective company taxation is defined as:

$$\begin{aligned} X_G &= T(X_O - X_D) - \gamma T(X_O - X_D) \\ &= T(X_O - X_D)(1-\gamma) \end{aligned} \qquad (104)$$

3. Therefore, in this representation, gamma is the proportion of tax collected from the company which gives rise to franking credits. Gamma can be considered as the proportion of company tax that is used as prepayment of personal tax liabilities.[653]

Substituting into EBIT yields:

$$X_0 = T(X_0 - X_D)(1-\gamma) + X_D + X_E \qquad (105)$$

Solving for X_0:

$$X_0 = \frac{X_E}{(1 - T(1-\gamma))} + X_D \qquad (106)$$

The weighted average cost of capital can be derived by substituting the perpetuity definitions of value.

652 Officer,RR (1994), "The Cost of Capital of a Company Under an Imputation Tax System", *Accounting & Finance*, 1994, pp. 1-17.

653 Hathaway, N.J., and Officer, R.R. (2004), *The Value of Imputation Tax Credits,* Working paper, Melbourne Business School.

Let

$$E = \frac{X_E}{r_e} \qquad D = \frac{X_D}{r_D} \quad \text{and} \quad V = \frac{X_O}{r_O}$$

Where:

E is the value of equity.

r_e is the required rate of return to equity holders after-company tax but before-personal tax.
D is the value of debt.
V is the sum of debt and equity.

r_D is the required return to debt holders after tax, i.e. the cost of debt capital.

r_O is the required return before taxes or the before-tax weighted average cost of capital (WACC).

Substituting these definitions into (106) yields the before-tax cost of capital:

$$r_o = \frac{r_e}{(1-T(1\text{-}\gamma))}.\frac{E}{V} + r_d.\frac{D}{V} \qquad (107)$$

Appendix 24 Issues with Dividend Drop-Off Studies

1. The imprecision in Dividend Drop Off studies arises from the presence of heteroscedasticity, multicolinearity and outliers in dividend data. Dividend drop off studies assert that after a stock distributes a dividend and franking credit, the resulting drop off in price is equal to the average value investors place on the dividend and franking credit, plus a random error term reflecting exogenous factors of the model. In order to estimate the value investors place on the dividend and franking credit, a large amount of historical dividend events are collected, and regression employed to the following equation:

$$P_{c,i} - P_{x,i} = \gamma_1 D_i + \gamma_2 FC_i + \varepsilon_i \qquad (108)$$

Where:

γ_1 is the value investors place on the cash dividend (also referred to as the net dividend), D_i , as a proportion of its face value;

γ_2 is the value investors place on the franking credit FC_i , as a proportion of its face value;

$P_{c,i} - P_{x,i}$ is the expected price drop-off from the cum-dividend day price $P_{c,i}$,to the ex-dividend day price $P_{x,i}$; and

ε_i is an error term designed to capture all other factors that influence the DDO outside of the cash dividend and franking credit.

2. Heteroscedasticity arises in the above equation as a consequence of the size of the error term being related to a variable associated with the dividend event. For example, it is well accepted that a stock with a high price will have a larger error relative to a smaller priced stock. This is due to the proportionally larger error caused by the distribution of a dividend and franking credit. Formally, heteroscedasticity refers to the non-constant variance of the error term. This can be expressed as:

$$\mathrm{Var}[\varepsilon_i \mid x_i] = \sigma_i^2 \qquad (109)$$

Where:

x_i is a variable related to observation *i*.

3. Variables identified in the literature as influencing the error variance include cum-dividend price[654], market capitalisation,[655] dividend yield,[656 657] and inverse stock return variance.[658] Intuitively, the dividend yield results in heteroscedasticity as stocks with larger dividends will cause a larger price drop-off, and as a consequence have a proportionally larger error. Stock price return variance refers to the historical volatility of the stock. A stock that is historically volatile over a

[654] Hathaway, N.J., and Officer, R.R. (2004), *The Value of Imputation Tax Credits,* Working paper, Melbourne Business School.

[655] Ibid.

[656] Ibid.

[657] Michaely, R. (1991), “Ex-Dividend Day Stock Price Behavior: The Case of the 1986 Tax Reform Act”, *Journal of Finance.*

[658] Bellamy, D. and Gray, S. (2004), “Using Stock Price Changes to Estimate the Value of Dividend Franking Credits”, Working Paper, University of Queensland, Business School.

long period of time is likely to have a larger error variance then a stock with low historical volatility, regardless of the size of the dividend paid.

4. Multicolinearity is another issue in Dividend Drop Off studies that causes imprecision in the estimate of theta. Multicolinearity refers to a linear relationship between the independent variables in a regression equation. Specifically, the explanatory variables are correlated. Multicolinearity results in an increase in the standard errors of the estimated regression coefficients, implying less precision in the resulting estimate. It is well documented that in situations where extreme multicolinearity arises, it is nearly impossible to separate the impact that the independent variables have individually on the dependent variable.[659] Multicolinearity can cause the estimated model to be extremely sensitive to changes in the underlying sample, regression technique used or the parametric form applied to the data.[660]

5. In dividend-drop off studies, multicolinearity arises from the fact that the franking credit is proportional to the size of the net dividend as follows:

$$FC_i = \frac{t_c}{1-t_c} D_i \times f_i \tag{110}$$

where

t_c is the corporate tax rate.

f_i is the franking proportion.

D_i is the net dividend.

6. As most dividends are fully franked ($f_i = 1$), a high degree of multicolinearity exists in dividend drop off data. As a consequence, it becomes difficult to differentiate the influence of the franking credit and net dividend on the price drop off separately.

7. The presence of outliers is cited as another weakness of DDO studies.[661] Outliers can have a large disproportionate influence on the regression coefficients, masking the underlying trend of the rest of the data. Outliers are distinct from heteroscedasticity in that they are not simply the result of a large variance, but rather indicate the inadequacy of the current model in explaining the data. Excluding outliers based on their influence on the regression coefficient can be seen as a form of data mining, which may exclude important information from the analysis.

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659 Berry, W.D. and Feldman, S. (1985) *Multiple Regression in Practice*, Sage Publications California, p. 41.

660 Berry, W.D. and Feldman, S. (1985) *Multiple Regression in Practice*, Sage Publications California, p. 41.

661 McKenzie, M.D. and Partington, G. (2010), Selectivity and Sample Bias in Dividend Drop-Off Studies, Finance and Corporate Governance Conference 2011 Paper, available at SSRN: http://ssrn.com/abstract=1716576 or http://dx.doi.org/10.2139/ssrn.1716576.