APGA
50 YEARS 1968–2018

Submission to the AER

2018 Rate of Return Guideline Draft Decision

25 September 2018

Contents

Key messages:

- It was broadly accepted in the AER's expert sessions that there is a difference in systematic risk between regulated electricity network and gas pipeline businesses. The difference can be quantified, and it should not be disregarded.
- AGPA submits evidence demonstrating there is no case that the beta for gas should be reduced below 0.7. In fact, beta is likely to increase in the future as investors consider the increased risk associated with climate change.
- The AER's MRP estimate is incongruous with the evidence and analysis presented. APGA submits the AER has erred in its formulation of the historical MRP, and places insufficient weight on forward-looking data for what is ultimately a forward-looking estimate.
- We submit substantive new evidence that demonstrates low beta bias is inherent in the SL CAPM and therefore bias exists regardless of whether expected or actual returns are observed. The AER recognised low beta bias in the SL CAPM in its 2013 Guideline and there is little justification for diverging from this position.
- We support the AER's return on debt approach in principle. The AER's decision to maintain most aspects relating to debt from its 2013 Guideline reflects the current evidence, and promotes stability, regulatory certainty and predictability. However, we have concerns about the role of S&P curve due to insufficient information available for us to engage meaningfully.
- The evidence relied upon by the AER to justify placing greater weight on Lally's top 20 ASX-listed firms approach and ABS data, while discounting ATO data in the gamma estimate, is not strong enough to merit the proposed departure from the 2013 Guideline approach.
- The AER's final parameter estimates would benefit from being transparent and replicable by all parties. The AER's Independent Panel shares this view.[1]
- The AER's reasoning is often not explicit and is difficult to ascertain. We recommend the AER places greater focus on presenting the method and judgement it relied on to reach its conclusion.

[1] *Independent Panel Review of the AER's Rate of Return Draft Guidelines*, 7 September 2018, page 62.

Introduction

The Australian Pipelines and Gas Association (APGA) welcomes the opportunity to make a submission on the AER's draft decision on its rate of return guideline (the Guideline). APGA is the peak body representing the owners and operators of Australasia's gas pipeline infrastructure. Our member businesses deliver all of the gas used in Australia.

We make this submission on behalf of regulated gas transmission pipeline and distribution network business in Australia, which will be bound by the Guideline. As owners and operators of some of Australia's most critical infrastructure, our members are directly impacted by the regulated rate of return and are an important voice in the discourse on the appropriate methodology for estimating it. The regulated rate of return influences the way gas pipeline businesses invest in their assets, their ability to attract investors to the Australian market, and ultimately the services they can provide customers. It is therefore vital the rate of return reflects the unique characteristics of gas pipeline businesses and the challenges of servicing Australia's gas market.

This brings us to the fundamental point we would like to raise in this submission; regulated gas pipeline businesses are distinct from regulated electricity network businesses. While the overarching commercial principles are similar, the systematic risk, investment drivers, financial leverage and market position of regulated gas pipeline businesses are substantially different to regulated electricity network service providers. It is therefore vital the methodology for estimating the binding rate of return for gas pipeline businesses takes these material differences into account.

Adjusting for risk through the cost of equity

APGA submits that the most practical method of reflecting regulated gas business' systematic risk exposure is to establish a separate benchmark equity beta from that applied to electricity businesses. We advise there is no case, in the evidence from Australian markets, to support reducing beta from 0.7 for gas businesses. We also submit new evidence that demonstrates the equity beta for Australian pure play gas pipeline businesses are not economically or statistically different from 0.7.

In its draft decision Explanatory Statement, the AER acknowledges the differing risks faced by electricity and gas businesses.[2] The potential for a separate equity beta to account for the difference in systematic risk was considered during the AER's concurrent evidence sessions, and *most experts agreed in the second evidence session that there were no strong theoretical reasons for believing that the beta of regulated electricity and gas should be the same.*[3]

APGA and other experts provided the AER evidence of overseas precedent that demonstrates the differing beta for gas networks, and there is general acceptance among experts that there

[2] AER, *Draft rate of return guidelines explanatory statement*, July 2018, section 2.4.2.
[3] Ibid.

is a difference in risk between the regulated gas and electricity businesses (though experts acknowledged it is difficult to quantify[4]).

Despite this expert advice, the AER appears to be leaning towards its conventional position that there should only be one benchmark beta for both gas and electricity. The AER considers it has received no substantively new material or information to that considered in its 2013 Guideline and subsequent regulatory decisions. The AER rejects the use of international evidence provided to it in May 2018[5] on the basis that using overseas regulatory precedent conflicts with its decision to only use domestic pure-play gas businesses as comparators due to differences in risk and regulatory environments.[6]

To help reconcile the AER's conflict, APGA presents new material based solely on Australian data. We asked HoustonKemp (S. Wheatley) to analyse data on the nine Australian firms the AER uses to form its comparator set.[7] Wheatley re-levers the AER's own data[8] to identify the difference between the equity beta of firms the AER deems to operate solely gas businesses and that of firms the AER deems to operate both gas and electricity.

Table 3 in the HoustonKemp Report (reproduced below) uses the AER's results. The table shows averages across firms the AER deems to operate solely gas businesses. The periods shown are those the AER uses; respectively the longest available, from the end of the tech boom to today, excluding the GFC and the last five years.

[4] Partington and Satchell. See AER, *Draft rate of return guidelines explanatory statement*, July 2018, page 102.
[5] APGA, *Submission to the AER review of the rate of return guideline,* May 2018, page 5.
[6] AER, *Draft rate of return guidelines explanatory statement*, July 2018, page 104.
[7] HoustonKemp, *Australian estimates of the equity beta of a gas business*, September 2018.
[8] AER, *Staff beta analysis*, June 2017.

Table 3: AER individual equity beta estimates: 1992 – 2017

Company	AER sector	Gearing	OLS estimate for period		
			1	2	3
Alinta	Gas	0.388	0.830	0.947	
			(0.110)	(0.129)	
AGL	Mixed	0.327	0.686	0.706	
			(0.064)	(0.098)	
APA	Gas	0.524	0.722	0.785	0.934
			(0.046)	(0.054)	(0.084)
AusNet	Mixed	0.595	0.399	0.561	0.789
			(0.058)	(0.060)	(0.090)
DUET	Mixed	0.707	0.342	0.377	0.309
			(0.064)	(0.066)	(0.103)
Envestra	Gas	0.696	0.372	0.361	
			(0.072)	(0.062)	
GasNet	Gas	0.643	0.350	0.353	
			(0.117)	(0.117)	
Hastings	Gas	0.450	1.302	0.927	
			(0.139)	(0.087)	
Spark	Mixed	0.632	0.391	0.414	0.484
			(0.065)	(0.074)	(0.094)
Mean gas			0.715	0.675	0.934

Notes: All beta estimates are re-levered to a gearing of 60 per cent. Standard errors are in parentheses below estimates.
Source: AER, Staff beta analysis, June 2017.

While the AER does not provide the information necessary to judge whether the gas betas are statistically significantly different from the existing allowance of 0.7, they appear to be similar or higher, except when the GFC is excluded from the data, which suggests gas betas may be only low in extreme economic conditions.

Table 4 in the HoustonKemp Report (reproduced below) shows Wheatley's individual security results. Wheatley has re-estimated betas following the AER's approach, calculating standard errors and identifying statistical significance.

Table 4: HoustonKemp individual equity beta estimates: 1992 – 2018

Company	AER sector	Gearing	OLS estimate for period 1	2	3
Alinta	Gas	0.364	0.945	1.087	
			(0.231)	(0.232)	
AGL	Mixed	0.323	0.692	0.678	
			(0.121)	(0.203)	
APA	Gas	0.524	0.699	0.762	0.952
			(0.064)	(0.068)	(0.124)
AusNet	Mixed	0.587	0.396	0.542	0.763
			(0.065)	(0.061)	(0.085)
DUET	Mixed	0.702	0.364	0.378	0.331
			(0.062)	(0.049)	(0.075)
Envestra	Gas	0.705	0.334	0.349	0.460
			(0.048)	(0.049)	(0.182)
GasNet	Gas	0.653	0.339	0.342	
			(0.094)	(0.094)	
Hastings	Gas	0.451	1.057	0.965	
			(0.227)	(0.159)	
Spark	Mixed	0.614	0.432	0.463	0.560
			(0.069)	(0.064)	(0.091)
Mean gas			0.675	0.701	0.827
			(0.072)	(0.065)	(0.101)
			[0.364]	[0.506]	[0.896]

Notes: All beta estimates are re-levered to a gearing of 60 per cent. Heteroscedasticity consistent standard errors are in parentheses while p-values for tests of the null hypothesis that beta is no less than 0.7 appear in brackets.

Wheatley's analysis shows that the gas results are only statistically significantly different from 0.7 for the longest of the AER's time periods, which suggests that it is only during extreme conditions (the tech boom and GFC) that gas betas fall substantially. We note the AER's previous beta estimate of 0.7 included the theory of the Black CAPM and international evidence, while the 2018 estimate does not. Regardless, under the AER's own changes to how it formulates a beta allowance, there is no scope for change from 2013 for gas. There is no scope at all for a movement downwards.

We accept that while the above results are interesting, they do not provide a categorical answer as to the equity beta of a benchmark efficient gas business. This is because even amongst the entities that the AER labels as gas businesses, few of them are pure play; most have some other lines of business, including electricity.

To provide a clearer guide on the beta of a pure play domestic gas business, Wheatley has also used the AER comparator set to produce a portfolio designed to be a pure play domestic

gas portfolio. The results are presented in Table 7 of the HoustonKemp report (reproduced below).

Table 7: HoustonKemp pure-play gas portfolio equity beta estimates

	Period		
	1	2	3
Estimate	0.588	0.640	0.878
Standard error	(0.049)	(0.051)	(0.119)
P-value	[0.012]	[0.122]	[0.933]

Notes: All beta estimates are re-levered to a gearing of 60 per cent. Heteroscedasticity and autocorrelation consistent standard errors are in parentheses below estimates while p-values for tests of the null hypothesis that beta is no less than 0.7 appear in brackets.

Again, the pure play gas businesses were found to have a beta which is only statistically significantly different from 0.7 during the longest time period which includes the extreme conditions of the tech boom and GFC. This evidence also indicates the beta for gas businesses should remain at least at 0.7.

The HoustonKemp report is provided in Appendix A to this submission.

We submit that this new evidence, drawn from domestic data, demonstrates that the appropriate beta to account for the greater risk faced by regulated gas businesses should be at least 0.7. This contrasts with the AER's draft decision that equity beta for both the gas and electricity benchmark efficient entity is 0.6.

While we do not propose the benchmark beta level for gas businesses should be set above 0.7, the Wheatley analysis shows that even when only considering Australian evidence, there is no justification for reducing the beta for gas below this level. Maintaining beta at 0.7 also offers a practicable and reasonable method of reflecting the risks faced by regulated gas businesses, while maintaining stability in the regulatory system (as would be expected from an incremental review).

In short, gas and electricity businesses are different, and there is no reason as to why they should be treated the same. This is clearly supported by the data.

Observations on the review process to date

APGA and its members have been active participants in the AER's review process to date, and we welcome the use of expert sessions and the commitment to greater transparency expressed by the AER. The ability to engage directly with the AER and its experts on an issue is a far more effective method of tackling the complex and theoretical nature of estimating the benchmark rate of return than merely submitting voluminous expert reports. Notwithstanding this, we consider improvements can be made to the engagement process, and in particular the way in which the AER's reasoning is presented. We echo the comments of the AER's Independent Expert Panel that the AER's Explanatory Statement:

> Should clearly set out all relevant reasoning, evidence and calculations with clear and specific references to other relevant documents that are publicly available.[9]

With this in mind, we provide the following observations on the process to date, and provide constructive feedback on how some aspects of the rate of return review (and the Explanatory Statement) could be improved in the future.

Replicability of method

In reviewing the AER's Explanatory Statement, we have found several instances where the AER's reasoning is difficult to understand, and there seems to be no way stakeholders can reasonably be expected to replicate how the AER used its inputs to achieve a particular answer.

An example of this is the AER's discussion on forming the range for beta. The AER ran more than 60 regressions (more than 100 if individual firms are included), which makes replicability difficult in itself. However, of greater concern is that the results presented do not show how the outputs from all 60-plus regressions have been used to inform the beta estimate. Only those results that support the AER's 0.6 beta conclusion are presented. Without a full picture of the AER's method of considering *all* information, it is not possible to reproduce (and understand) the AER's beta estimates with any confidence.

To aid transparency and replicability of the Guideline, we recommend the AER presents its Explanatory Statement in a subtly different way. At the moment, the Explanatory Statement presents the information relied upon to justify the AER's parameter estimate and provides exhaustive commentary on why that point estimate is correct (similar to the approach taken during limited merits reviews).

A more transparent (and preferred) method would be to present all evidence considered, and rather than focus on why the answer is correct, simply walk through the analysis that was applied to each piece of evidence in order to reach the answer. A capable of acceptance decision would clearly show the reasons and/or analysis that has led to a change from the 2013 Guideline.

This is the approach the ERA in Western Australia took in its 2016 final decision on the access arrangement for the Dampier to Bunbury Natural Gas Pipeline (DBNGP) for the estimation of beta.[10] The ERA limited the number of regressions to a more manageable level (for example considering one equal and one value-weighted portfolio), presented the results of the whole analysis and mapped out the simple rules it followed to obtain its final estimate; in this instance, it was simply the average of the equal and value weighted portfolio results.

By presenting the parameter explanations as per the ERA's DBNGP equity beta method, irrespective of whether one agrees with the end answer or the method itself, it can be clearly seen how the regulator has reached its point estimate. This means the method can be

[9] *Independent Panel Review of the AER's Rate of Return Draft Guidelines*, 7 September 2018, page II.
[10] ERA, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline 2016 – 2020, Appendix 4*, June 2016.

replicated by all parties. We recommend the AER adopts a similar approach in its Explanatory Statement for its final Guideline.

Drawing upon the Independent Panel's direction that:

> *where including a full explanation would be too technical or long-winded, the Explanatory Statement should provide clear and specific references to other relevant documents in the public domain*[11],

we recommend the AER's Explanatory Statement should present a concise and unambiguous path from input to output that is replicable to any diligent reader and clearly shows the AER's reasoning.

Evidence asymmetry

We have also observed instances where the AER is inconsistent in its treatment of evidence provided by experts, particularly where that evidence results in a higher rate of return or a variation from the AER's historical position.

For example, and illustratively important to the point, when considering the use of arithmetic versus geometric means in determining the market risk premium (MRP), the AER's own expert, Dr Martin Lally, has provided a mathematical proof that the market risk premium in the Post Tax Revenue Model (PTRM) requires it to use arithmetic averages. Several other experts made the same point in the expert conclave. However, rather than conceding the clear weight of evidence that little or no regard should be given to the geometric mean, the AER justifies its continued use of the geometric mean by instead placing significant weight on suppositions that investors may compound returns in general. This approach seems contrary to the way the PTRM actually works.

The way the AER presents evidence relied upon is also not symmetrical. The AER presents arguments why it is not appropriate to give weight to the arithmetic mean, despite all experts supporting its use. The AER also gives no weight to forward-looking DGM, which most international regulators rely on and is the one method consistent with a forward-looking CAPM framework. However, the AER relies upon the geometric mean but offers little explanation why it should be considered superior to the arithmetic mean or how it was applied. The Independent Panel notes in its report that:

> *It is common in corporate finance practice to rely on long-run arithmetic averages of historical MRP..... The Explanatory Statement also notes a long-run geometric average of 5.0 per cent, which it uses as a floor for a MRP range of 5.0 per cent to 6.5 per cent. It acknowledges 'that the geometric average is downwardly biased.'64 But the AER also considers the extra information the geometric average returns provide when determining an estimate for the MRP.65 The Explanatory Statement does not identify*

[11] *Independent Panel Review of the AER's Rate of Return Draft Guidelines*, 7 September 2018, page V.

the information provided by the geometric average and does not explain how that information was used in making the 6 per cent MRP estimate.[12]

We are concerned by the AER's draft decision not to adjust its position even when presented with compelling mathematical and replicable evidence on a number of fronts. The purpose of this review process is to ensure the Guideline results in a rate of return that best promotes the National Gas Objective, which does not necessarily equate to binding network businesses to the lowest defensible return on investment.

This is key to achieving a Guideline capable of being accepted by all stakeholders – one that provides balanced consideration of the evidence and clearly explains the link between the 2013 Guideline, the updated evidence and the AER decision.

Use of experts and the Independent Panel

The use of expert conclaves and an Independent Panel has been a positive step in the review process to date. Bringing together regulatory and economic experts to deliberate the merits of various estimating approaches is a valuable exercise and a much more efficient approach than the customary written reports normally exchanged during a price review process.

Similarly, we support the appointment of an Independent Panel to help test the estimating approach and be an advocate for clarity and robustness of the AER's reasoning. We consider the Independent Panel has provided a useful and alternative layer of scrutiny on the process, and we strongly urge the Panel's remit to be expanded further in the future.

We recommend that the Independent Panel would benefit from being invited to the expert sessions – as an impartial observer – so that the Panel members can witness the perspectives of all parties, appreciate the breadth of information provided to the AER, and factor these into their report. Though the Independent Panel's report has provided some useful insight on a draft decision they were only afforded a short time frame to assess, we consider the Panel's contribution would be enhanced if they were involved earlier in the process. Not only would this make the Panel's task easier, it would allow them to get a fuller picture of what the major points of contention are, and focus their energies on addressing the material issues.

For example, we note that in its report the Independent Panel has suggested some fairly major changes in the cost of debt (discussed later in this paper). As the AER will be aware, the cost of debt is an area on which stakeholders have generally agreed, therefore we found it surprising that it fell under considerable scrutiny from the Panel. Had the Independent Panel been provided visibility of the debt discussions to date, it is likely they would have focussed more acutely on the issues that would benefit most from their counsel, such as equity or gamma.

We also suggest an important part of the Independent Panel's remit in the future could be to assess the quality of the expert sessions and whether the advice provided during the expert sessions is applied reasonably and objectively. During the review process, even when experts

[12] Ibid, page 33.

gave the AER clear advice on a particular topic, there were occasions where the AER responded that the experts might have provided different advice if they had considered the issue more fully, and have subsequently disregarded the expert advice on this basis.

Disregarding expert advice on the premise that the experts may change their minds if given more time is a concerning practice, and does not reconcile with a transparent and balanced review process.

There were also a number of occasions where the AER signalled that:

> *"Not all experts were (fully) available over the course of preparing the expert joint report to present their views….."*[13]

We suggest that given the importance of expert input in determining a rate of return that will bind regulated businesses for five years, sufficient effort should be applied to make sure all the nominated experts are able to share their expertise.

We suggest the Independent Panel could be a useful barometer to ensure the expert conclaves are fully utilised and the advice provided is applied in a reasonable and balanced manner.

Incremental change

APGA would also like to comment on the level of material change proposed in the draft Guideline when compared with the AER's 2013 Guideline. As stated in our May 2018 submission[14], throughout this process we have supported the notion of incremental change given a guideline already exists.

To ensure change is incremental and appropriate, our understanding was that the starting point for the 2018 Guideline would be the end point of the analysis undertaken for the 2013 Guideline and subsequent review (including through the Australian Competition Tribunal). We consider this is a reasonable assumption and is one held by many of our members. This also appears consistent with the views put forward by the AER in its October 2017 issues paper:

> *Given this history, we consider this review should seek to build on the current Guideline rather than start afresh. There are a number of aspects of the current approach that are reliant on market data and empirical analysis, and this material would clearly need to be updated. However, there are a number of aspects of the current approach that are driven by finance theory and available academic literature. We not aware of any significant new developments in this area that might warrant us taking a new approach.*[15]

In keeping with this assumption, substantive changes to the 2013 estimating approach should only be necessary where there have been material changes in risk, evidence, market conditions and/or finance theory since then. However, many of the changes the AER proposes in its draft Guideline are considerably more than incremental and inconsistent with

[13] AER, *Draft rate of return guidelines explanatory statement,* July 2018, pages 202, 247, 264.
[14] APGA, *Submission to the AER review of rate of return guideline*, May 2018, page 2.
[15] AER, *Issues paper, Review of the rate of return guidelines*, October 2017, page 8.

the guidance provided by all stakeholders. For example, the AER's application of its foundation model for estimating the return on equity appears to have departed considerably from its 2013 application, with entirely new analysis being applied to accepted principles such as the theory of the Black CAPM, international evidence on beta and weighting of dividend growth model (DGM) studies.

We do not contend that elements within the AER foundation model approach (or any other parameter for that matter) should not be revaluated during each Guideline review. However, in the interests of predictability and stability, the foundation model should be more than simply a six-step methodology to estimating the cost of equity – the analysis applied to each of those six steps should also be consistent.

Applying consistent analysis to the foundation model would mean the model outputs would only result in materially different conclusions if there has been a corresponding material change in risk, market conditions or finance theory. Adopting this approach would better satisfy the requirement for the regulated rate of return to reflect the prevailing market conditions.

We submit market conditions have not changed significantly since 2013, therefore there is little cause for significant change in the way the cost of equity is estimated. Similarly, with regard to the value of imputation credits, the AER appears to have abandoned an approach that has been established via numerous exhaustive review processes in recent years, in favour of a revised method that is not supported by robust evidence.

Divergence from the status quo without clear justification, necessity, or a clear link to a relevant change in market conditions is inconsistent with the principles of stability and predictability; principles which the AER accepts are valued by industry and consumers[16] and are purported to feature in the AER's deliberations.[17]

We consider a prudent step missing from the AER's rate of return estimating methodology (or at least the Explanatory Statement) is the top-down assessment of whether parameter estimates reflect real-world circumstances and whether any changes in methodology are commensurate with changes in the market. We recommend it would aid transparency and acceptance of the Guideline if the AER demonstrated how it has tested that the individual parameters and the overall rate of return (and gamma) result in an outcome that is neither too high nor too low to promote the National Gas Objective and the Revenue and Pricing Principles.

We are keen to see a better link between the current Guideline, the updated evidence, any relevant changes in finance theory that have been considered and the AER decision.

[16] AER, *Draft rate of return guidelines explanatory statement,* July 2018, page 46.
[17] Throughout the AER's discussion of its rationale for determining equity beta, the AER states that is takes into account the need to promote stability and predictability; for example see Explanatory Statement, page 53.

Setting the rate of return parameters

APGA would also like to comment on the various estimates the AER has made for each rate of return parameter. In the following section we provide observations on the AER's method, recommendations on new evidence the AER should consider when finalising the Guideline, and advice on how the AER may achieve a more robust parameter estimate.

In each case, we divide our discussion into two parts:

- observations on the evidence and method used by the AER to reach its parameter estimate; and
- recommendations on how to improve the robustness of the parameter estimate and/or its explanation.

Market risk premium – observations

APGA's view is that the market risk premium (MRP) is best estimated by:

- estimating the historical MRP from the arithmetic average of historical excess returns, affording no weight to the geometric mean (consistent with expert views);
- estimating the forward-looking MRP by using DGM estimates; and
- determining the MRP point estimate as the mid-point between the historical MRP and the forward-looking MRP.

We consider the AER's draft MRP point estimate of 6.0 per cent is not appropriate because:

- the AER has relied on the geometric mean to estimate the historical MRP, being provided a consensus view from the expert panel that this is not appropriate, including a mathematical proof by Lally that the arithmetic mean must apply;
- the AER continues to rely on Brailsford Handley Maheswaran (BHM) calculations of historical excess returns. New (2015) data that was not available during the 2013 Guideline review shows that the NERA data provides a more robust estimate;
- the AER has significantly shifted its approach since the 2013 Guideline, no longer giving sufficient weight (if any) to DGM estimates despite no change in finance theory.

These points are discussed below.

Perhaps more significantly, the AER's proposed reduction in MRP from 6.5 per cent to 6.0 per cent seems incongruous with the evidence presented. All of the estimates the AER examines in its MRP deliberations have increased since the 2013 Guideline[18], yet the AER's point estimate is moving in the opposite direction.

Use of the geometric mean

As mentioned earlier in this paper, experts have produced clear evidence that demonstrates sole weight should be placed on the arithmetic mean of historical returns, and that the

[18] See, for example, Table 2 in the Explanatory Statement, which shows that all of the historical estimates increase, and Figure 20 in the Explanatory Statement, which shows the range of DGM estimates have also increased (once the variable growth rate estimates, which were not used in 2013 and which the AER's own experts do not support, are removed).

geometric mean is of limited value (there is certainly no basis for increasing the weighting on geometric means, as the AER has done).

Berk and DeMarzo consider the application of the arithmetic and geometric means in MRP estimation, stating:

> *Because we are interested in the expected return, the correct average to use is the arithmetic average.*[19]

In the second concurrent evidence session, several experts explained that the AER uses the historical excess returns data to estimate the expected MRP in a setting where returns are not compounded, and that this mathematically requires the arithmetic mean.

Lally has previously considered whether an arithmetic or geometric mean should be applied to the historical data. He evaluates whether each form of average is consistent with the NPV=0 principle and concludes that:

> *The geometric mean fails this test whilst the arithmetic mean will satisfy it if annual returns are independent and drawn from the same distribution. So, if historical average returns are used, they should be arithmetic rather than geometric.*[20]

Lally has also derived a mathematical proof that confirms the arithmetic mean should be applied.[21]

However, rather than accepting this expert advice and accepting the mid-point of the range of arithmetic means (6.25 per cent) to arrive at the historical MRP, the AER has placed material weight on the geometric mean in order to reduce the mid-point of the range to 6.0 per cent.

This adjustment appears to be based solely on the assertions of Partington and Satchell in a report commissioned by the AER[22], where they suggest that investors may consider compound returns if they have long investment horizons.

Notwithstanding the fact that the AER appears to be placing greater weight on a supposition than on a mathematic proof, the AER's adjustment is not valid. The mathematical proofs already account for long investment horizons, therefore there is no need to make a further adjustment on this basis.

The Independent Panel has also noted that it is common in corporate finance to rely on arithmetic averages. We therefore advise that the arithmetic means evidence should be solely relied upon and supports a historical MRP range of 6.0 per cent to 6.5 per cent, with a mid-point of 6.25 per cent.

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[19] Berk, J., DeMarzo, P., *Corporate Finance,* 2017, page 406.
[20] Lally, M., *Review of the AER's Methodology for the Risk Free Rate and the Market Risk Premium*, 4 March 2013, page 40.
[21] Lally, M., *The Cost of Equity and the Market Risk Premium*, 25 July 2012, page 31-32.
[22] Partington, G. & Satchell, S., *Report to the AER: Allowed rate of return 2018 Guideline Review*, May 2018.

Use of BHM data

We also submit that NERA data provides a more robust estimate than the BHM data on which the AER solely relies.

In a submission to the AER in June 2013, NERA (2013)[23] identified and corrected a number of inaccuracies in the adjustments that were made in the BHM (2008, 2012)[24] calculations of historical excess returns. The improved quality of the NERA data has been recognised by leading experts, most notably Dimson, Marsh and Staunton, who switched to using the NERA data in 2016, highlighting in the 2018 Credit Suisse Global Investment Returns Yearbook that the NERA data provides a superior estimate of historical rates of return.[25]

The superiority of NERA data over BHM data was also recognised by the experts during the current review process, with the CEPA Joint Expert Report documenting that no expert disagreed with the proposition that:

> *The HER [historical excess returns] data should use the "NERA" adjustments that Dimson, Marsh and Staunton employ in recent Credit Suisse Global Investment Returns Yearbooks.*[26]

Given this clear expert advice, coupled with the new evidence from Credit Suisse that NERA data are the new standard, we submit the AER should afford no weight to BHM data and use solely NERA data instead.

DGM weighting

With regard to the AER's use of the dividend growth model (DGM), we submit the DGM should be afforded greater weight in the MRP estimate. As Berk and DeMarzo state:

> *Using historical data to estimate the market risk premium suffers from two drawbacks. First, despite using 50 years (or more of data), the standard errors of the estimates are large . . . . Second, because they are backward looking, we cannot be sure that they are representative of current expectations.*
>
> *As an alternative, we can take a fundamental approach toward estimating the market risk premium. Given an assessment of firms' future cash flows, we can estimate the expected return on the market by solving for the discount rate that is consistent with the current level of the index.*[27]

In its Explanatory Statement, among the many issues the AER raises with the DGM is the range of potential growth rates of dividends per share, which the AER states can vary from as

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[23] NERA, *The market, size and value premiums*, June 2013.

[24] Brailsford, T., J. Handley and K. Maheswaran, *Re-examination of the historical equity risk premium in Australia, Accounting and Finance 48*, 2008, pages 73-97; Brailsford, T., J. Handley and K. Maheswaran, *The historical equity risk premium in Australia: Post-GFC and 128 years of data*, *Accounting and Finance*, 2008, pages 237-247.

[25] Credit Suisse, *Global Investment Returns Yearbook 2018*, page 87.

[26] Cambridge Economic Policy Associates, *Expert Joint Report*, 21 April 2018, page 59.

[27] Berk, J., DeMarzo, P., *Corporate Finance,* 2017, page 407.

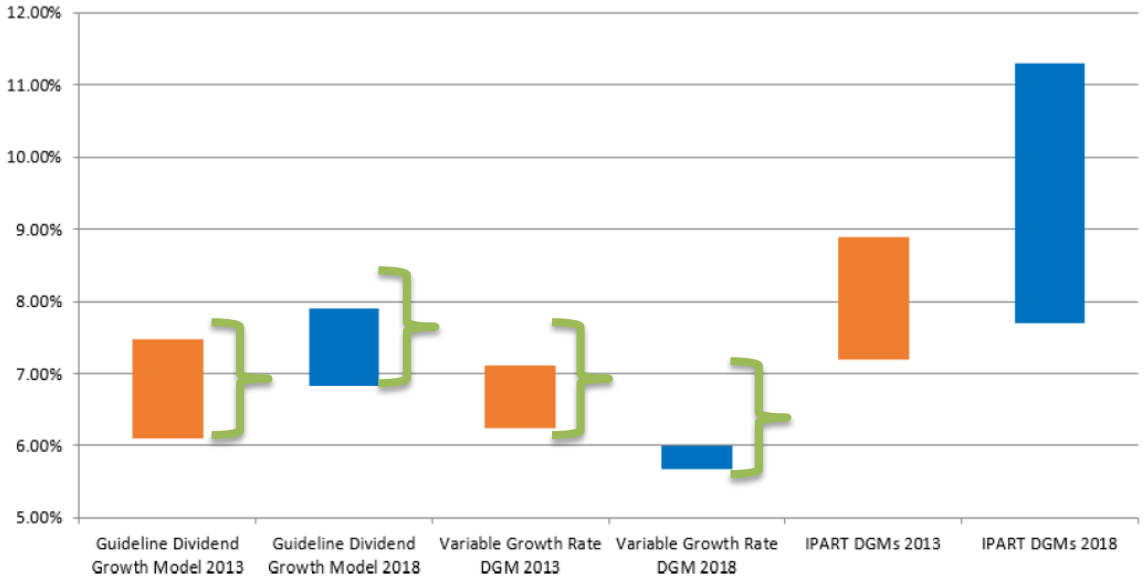
low as 1 per cent to as high as 5.5 per cent.[28] The AER then uses this variability as the basis for effectively disregarding the validity of DGM-based MRP estimates.

However, the range of 1 to 5.5 per cent appears to mix real and nominal numbers, and the lower bound has been challenged even by the AER's own experts. Fixing this issue, if inflation is 2.5 percent per annum as per the RBA mid-point that the AER uses as its long-term estimate, results in a range that is not significantly larger than in 2013[29], when the DGM was acceptable to the AER.

We are aware the ENA has provided an expert report by Simon Wheatley who suggested a way of linking the growth of dividends per share (the aspect of the DGM subject to greatest variability) to GDP growth at the expert sessions. This work shows that it is possible, with confidence, to put a range of roughly one hundred basis points around a central estimate of the growth of dividends per share, thus obviating the AER's main concern with the DGM. This is a smaller range than the AER found in 2013.

Moreover, Figure 20 in the AER's Explanatory Statement shows that the DGM range in the AER's 2018 Guideline is smaller than the range in the 2013 Guideline. It is also worth noting that the AER's range of DGM estimates is smaller than its range of historical MRP estimates. We have replicated Figure 20 below and highlighted (with green brackets) the scale of the range of estimates for the historical MRP.

Figure 20 Results from various DGM constructions from 2013-2018



Given the AER gave weight to the DGM in the 2013 Guideline, it is unclear why the AER considers the DGM range to be an issue today (again, including because there has been no change in finance theory). Further, given that the AER's own historical estimates have a greater range than its DGM estimates, we are unable to reconcile why the AER considers the

[28] AER, *Draft rate of return guidelines explanatory statement*, July 2018, page 45.
[29] Ibid, page 218.

DGM has too wide a range, but the historical estimates do not.[30] This needs to be explained if the draft decision is carried through to the final.

Like most models used to estimate the theoretical regulated rate of return, the DGM is not without its flaws, and we do not necessarily consider it should be afforded any more or less weight than historical estimates. However, the DGM introduces forward-looking evidence that helps balance what would otherwise be a purely historical approach. We consider its use in combination with historical market risk premia contributes to a robust MRP estimate.

In the interest of balance, we submit the DGM should be afforded a weighting of 50 per cent, at least as a starting premise when estimating the MRP, and that a transparent, symmetric process of adjusting evidence based on mitigating factors then be applied. This is particularly important given the requirement to ensure that the cost of equity reflects prevailing conditions in the market for funds.

Market risk premium – recommendations

We recommend the AER could adopt one of two approaches to improve transparency. The first approach is to use its 2013 Guideline as a starting point and look to changes in data since then.

In 2013, the MRP allowance was 6.5 percent, and the AER relied upon both historical data and the DGM. Since then, historical data has seen an increase of 4.5 per cent[31] and the DGM has seen an increase of 5.4 per cent for the lower bound and 11.5 percent for its upper bound. Therefore, if 2013 is the starting point, there's no scope for the MRP to move down, because all of the primary evidence has moved up. Instead, in keeping with the evidence, the AER should either keep the same result, or increase it slightly. This would clearly show stakeholders how the results were derived, and would provide a strong signal of continuity.

The second approach is to consider the evidence as it stands at present, and work through a process of moving from a range to a point estimate in a transparent way. A worked example could be:

- Step 1 – begin with current estimate of 6.5 per cent.
- Step 2 – using arithmetic means only, this is 6 to 6.5 per cent (after taking into account the NERA adjustment, which would raise the estimates a little). Choose a mid-point, say 6.25 per cent to be a historical estimate.
- Step 3 – estimate a feasible range of the DGM estimates, say the estimated range is is 6.8 to 7.85 per cent. Choose a mid-point of 7.3 per cent in this case as the estimate based on forward looking data.
- Step 4 – take a weighted average of 6.2 per cent and 7.3 per cent depending on AER's judgement. Assume 70:30 weighting for historical average to DGM estimate – this would result in an estimate of 6.5 per cent.

[30] We recognise that, were the AER to follow our advice and remove consideration of the geometric mean, the historical estimates would have a narrower band than those produced by the DGM.
[31] AER, *Draft rate of return guidelines explanatory statement*, July 2018, page 45.

- Step 5 – AER to consider whether the new estimate is significantly[32] different from current estimate of 6.5 per cent. If significantly different then change to new estimate and if not then continue with existing estimate.

Equity beta - observations

Notwithstanding the need for beta to reflect the greater systematic risk of gas pipeline business, we make some further observations on the AER's beta estimate.

Our first observation is the complexity of the estimate. Discussion of the AER's beta estimation method spans some 86 pages of its Explanatory Statement, yet it remains unclear exactly how the AER has selected its point estimate. The key pages (pages 250-258) focus on presentation of evidence to support the new range (0.4 to 0.8) and point estimate (0.6), rather than explaining how this estimate was arrived at. This is problematic given the AER's beta allowance has declined since its 2013 Guideline, whereas empirical estimates have actually increased over the same period.

We appreciate that estimating methodologies are imprecise and require judgement, however, we advocate that any use of judgement should be clearly explained and the AER's parameter estimates should be transparent and replicable by all parties.

Our second observation on the AER's beta estimate is that it provides disproportionately high weight to data more than ten years out of date and disproportionately low weight to more recent data. This is exacerbated by the retention of de-listed firms in its comparator sample, which has the sole effect of freezing data in time. We are aware some experts said that retaining old data might be appropriate if beta was constant, or if it cycled, and the AER has used this as a justification.[33] However, the AER provides no evidence that beta is now stable or that it cycles. In fact, the AER appears to disregard the rising trend in beta since 2013.

The AER states:

> *We observe some increase in estimates since the 2013 Guidelines. However, the overall empirical results, particularly the longest estimation period, support a value of less than 0.7.*[34]

Given the challenge is to estimate a forward-looking rate of return commensurate with prevailing market conditions, one would consider it prudent to place greater confidence in more recent beta estimates taken from live firms than ageing data from de-listed firms. This is a point made clear in the CEPA Expert Joint Report, which states experts agreed that the weight placed on the estimates should decline in line with the length of the time since delisting.[35] However, the AER appears to have disregarded this advice on the basis that

[32] A definition of 'significant' could be 25bps, for example).
[33] AER, *Draft rate of return guidelines explanatory statement*, July 2018, pages 264 and 271.
[34] Ibid, page 244.
[35] Cambridge Economic Policy Associates, *Expert Joint Report*, 21 April 2018, page 47.

> *.. not all experts were (fully) available over the course of preparing the expert joint report…*[36]

We find it disappointing that the AER has summarily dismissed this expert advice, and recommend it gives the use of contemporary data further consideration and weight. All experts had the same time and opportunity to contribute to this process. This explanation, is our view, undermines the consultation process that the AER has run.

We are also concerned by the AER's view that:

> *We give most weight to estimates from the longest estimation period because short term estimates can be unduly influenced by factors such as one-off events (for example, the Global Financial Crisis), shocks and interest rate movements.*[37]

The AER makes this assertion without providing any evidence that the short term estimates have been distorted, or explaining how it has accounted for distortions on longer term estimates – for example the distortion caused by retaining de-listed firms. Short term estimates, which include live data and recent trends, are most likely to reflect prevailing market conditions. We find it counter-intuitive for the AER to conclude otherwise without presented reasoned analysis for reaching this conclusion.

Note we are not proposing beta estimates should only be drawn from the most recent five years (although this would be a reasonable position to take). It is much more common for shorter estimates to be used[38], and this should be reflected in the AER's reasoning. We conservatively submit that equal weighting should be given to long and short term estimates, or if a movement away from equal weighting is justified, a reasoned explanation be provided as to why and how each observation period has been weighted proportionately.

Equity beta – recommendations

As noted above, we recommend the AER aims to achieve a level of transparency consistent with the beta methodology outlined by the Economic Regulation Authority (ERA) in its 2016 Final Decision for DBNGP. We consider the ERA's estimating method was well reasoned and sufficiently explicit to enable the reader to understand and replicate its estimate. Table 2 from the ERA's DBNGP Final Decision Appendix 4 (reproduced below) is a useful example of how the 'best' estimate can be seen in one table.

[36] AER, *Draft rate of return guidelines explanatory statement*, July 2018, page 244.
[37] Ibid, page 243.
[38] Campbell, J. Y., Lo, A. W., and MacKinlay, A. C., *The Econometrics of Financial Markets,* 1997, page 182.

Table 2 **Estimates of equity beta for individual firms and the two weighted portfolios in May 2016 for different estimation methods**

	APA	AST	DUE	SKI	Mean Assets	EW	VW	Mean Portfolios	Mean All
Gearing	0.440	0.562	0.627	0.277	**0.476**	0.476	0.484	**0.480**	0.477
OLS	0.682	0.671	0.170	0.716	**0.560**	0.638	0.665	**0.652**	0.591
LAD	0.662	0.705	0.243	0.724	**0.584**	0.740	0.778	**0.759**	0.642
MM	0.665	0.675	0.268	0.776	**0.596**	0.703	0.715	**0.709**	0.634
T-S	0.647	0.661	0.263	0.713	**0.571**	0.669	0.681	**0.675**	0.606
Mean OLS, LAD, MM, T-S	**0.664**	**0.678**	**0.236**	**0.732**	**0.578**	**0.687**	**0.710**	**0.699**	**0.618**
ARIMAX	0.683	0.636	0.164	0.690	**0.543**	0.620	0.651	**0.636**	0.574
GARCH	0.618	0.673	0.254	0.731	**0.569**	0.677	0.681	**0.679**	0.606
Mean of all above methods	**0.660**	**0.670**	**0.227**	**0.725**	**0.570**	**0.675**	**0.695**	**0.685**	**0.609**

Source: ERA, DBP FD App4 p102. Note we would not advocate the use of ARIMAX and GARCH models for a non time-series model like the CAPM. They add little to the analysis, and do not appear to have been used in 2016 to inform the ERA's results.

The ERA describes its reasoning as:

> *Drawing on the results reported in Appendix 4A, the Authority considers that a 95 per cent confidence interval range of equity beta using the most recent data is from 0.479 and 0.870 based on the portfolio results (see Appendix 4A, Table 21 and Table 22). The central estimate given by the average of the portfolios is 0.699. The Authority notes that portfolio estimates have a narrower range than the individual assets.*
>
> *Based on its own analysis and the other evidence before it, together with the recognition that estimates of equity beta from empirical studies exhibit a high level of imprecision, the Authority is of the view that the point estimate of equity beta of 0.7 (rounded) provides a conservative and appropriate central best estimate for beta for use in the SL-CAPM.*[39]

The ERA then provides a clear indication of the precision of its estimate, as shown in Table 22 of the DBNGP Final Decision Appendix 4 (reproduced below) using confidence intervals rather than an unclear range determined by the mean estimates of dozens of similar regressions.

[39] ERA, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline 2016 – 2020, Appendix 4*, June 2016, page 102.

Table 22 Summary of Bootstrap Simulated Statistics of Robust Estimators (B=10,000, n=261)

Model	Estimator	APA	AST	DUE	SKI	Mean Assets	EW	VW	Mean Portfolios	Mean All
LAD	$\hat{\beta}$	0.662	0.705	0.243	0.724	**0.584**	0.740	0.778	**0.759**	0.642
	Standard Error $\hat{\beta}$ [1]	-	-	-	-	-	-	-	-	-
	Bootstrap $\hat{\beta}$	0.654	0.677	0.258	0.789	**0.595**	0.747	0.748	**0.748**	0.646
	Bootstrap S.E. $\hat{\beta}$	0.114	0.077	0.066	0.158	**0.104**	0.110	0.084	**0.097**	0.101
	Bootstrap Bias	-0.028	0.006	0.088	0.073	**0.035**	0.109	0.082	**0.096**	0.055
	Bootstrap LB 2.5%	0.437	0.543	0.156	0.434	**0.392**	0.479	0.529	**0.504**	0.429
	Bootstrap Median	0.658	0.678	0.248	0.771	**0.589**	0.765	0.762	**0.764**	0.647
	Bootstrap UB 97.5%	0.873	0.847	0.415	1.089	**0.806**	0.896	0.870	**0.883**	0.832

Source: ERA, DBP FD App 4 p195. Note that this is not the whole table, and the confidence intervals for the OLD estimates are on a separate table. However, it seems what the ERA has done is chosen the lowest (amongst its regression methods) 2.5 percent value, and the highest 97.5 percent value. This might not be strictly accurate from a statistical perspective, but it is clear.

As discussed earlier in this submission[40], while we might disagree with the ERA's beta estimate, we can see how they have arrived at the result. Rather than focusing on why its point estimate is correct, the ERA instead presents all information considered, explains how it interpreted that information, and shows the path it followed to reach that estimate. We consider this is a much more transparent approach than in the AER's draft decision Explanatory Statement, where the bulk of analysis appears to be on the reasons why its equity beta decision has merit rather than how it arrived at the point estimate. This approach assists in building confidence in the decision and supports a Guideline capable of being accepted (including because stakeholders understand how their information has been considered).

Low beta bias – observations

APGA maintains its position that the low beta bias inherent in using the Sharpe Lintner Capital Asset Pricing Model (SL CAPM) to estimate the return on equity should be accounted for when selecting the beta point estimate.

The AER concludes in its draft Guideline that the evidence of low beta bias comes from actual returns, and that that this is largely irrelevant because its task is to estimate expected returns. We do not agree that actual returns could have no impact on the formation of investors' expectations, particularly given low beta bias is one of the most well documented findings in finance over the past 50 years.

[40] See 'Observations on the review process'.

However, we acknowledge that the AER has formed this view and, rather than submit more evidence based on actual returns, we submit substantive new evidence that demonstrates:

- bias exists even when one only considers expected returns; and
- the bias is actually bigger than that of actual returns.

The new evidence, produced by Frontier Economics (S. Gray), is attached at Appendix B. The Frontier Economics report follows a methodology developed in a seminal paper by Brav et al (2005)[41], and adapts that methodology for Australian data. This analysis uses analyst forecasts, rather than actual returns.

Gray finds, consistent with Brav et al, evidence of systematic bias in respect of the predictions of the SL CAPM. This means low beta bias is not simply something associated with differences between expected and actual returns; it is present in expectations as well.

This points to an important conclusion; the CAPM is just one model of expectations, and it is an imperfect model.

Therefore, if the AER seeks a proxy for the expected return in the marketplace for bearing the level of systematic risk of the benchmark efficient entity, it cannot merely apply the textbook CAPM. It must also make an adjustment to account for the imperfections in the model it uses.

We submit that the AER recognised the imperfections of the SL CAPM in 2013 and made a necessary adjustment to the model[42], though we accept that the AER did not adjust for low beta bias per se.

Our key point is that the specific departure made from 2013 to the draft Guidelines of removing all adjustments to the pure SL CAPM is in error, and this is reinforced by Gray's report on expected returns.

We also submit that the position put forward in our May 2018 submission in respect of the AER's use of expected equilibrium returns remains valid, and we were not simply looking for a justification of the use of actual returns. While we do not intend to re-state all of the arguments from that submission in this paper, we would like the AER to clarify its use of the expected equilibrium framework, as this lies at the core of considerations about low beta bias.

What we are seeking clarity on is whether in its beta estimation the AER is assuming the market is in equilibrium or not. It is currently unclear from the AER's Explanatory Statement whether the AER is adopting the 'expected equilibrium framework' exhorted by Partington and Satchell.[43] Then, whether the AER considers the market is in equilibrium or in disequilibrium, we urge the AER to recognise the limitations of both and make the necessary adjustments.

[41] Brav, A., Lehavy, R., Michaely, R., Using Expectations to Test Asset Pricing Models, 2005.
[42] AER, *Draft rate of return guidelines explanatory statement*, July 2018, page 275.
[43] See Partington G and Satchell, S, 2016, *Report to the AER: Cost Of Equity Issues - 2016 Electricity And Gas Determinations*, April 2016, Partington G and Satchell, S, 2016, *Report to the ERA: The Cost Of Equity And Asset Pricing Models*, May 2016, Partington G and Satchell, S, 2017, *Report to the AER: Discussion of Submissions on the Cost of Equity*, June 2017.

If the market is in disequilibrium (that is, the AER is not assuming some kind of "expected disequilibrium framework"), then market data have no relevance. It is still mathematically possible to determine a beta via regression analysis, but that beta will have no relevance at all in explaining anything about risk, because the CAPM is an equilibrium theory, and has nothing to say in conditions of disequilibrium. It is for this reason that Gray (see Appendix B) and the AER's own experts Partington and Satchell[44] suggest the AER assumes markets do form equilibria and investors expect them to do so. We also suggest that assuming markets are out of equilibrium for long periods of time[45] offers little insight, which is why experts caution against doing so.

If markets do form equilibria, then models of investor behaviour have relevance. It is worth noting that the SL CAPM is not the only equilibrium model that has been developed.

If actual returns do not match the predictions made by an equilibrium model like the SL CAPM but there was no persistent pattern to the finding, using the SL CAPM would have value as the variance could be explained by random shocks to the market.

However, if there are;

- persistent differences between actual returns and the predictions of one particular equilibrium pricing model; and
- the pattern in almost every time period and country is in the same direction; and
- there is similar evidence of persistent error using genuine expectations;

then the equilibrium model being used must be considered to have flaws requiring remedy.

Brav et al and Gray find this to be the case with the SL CAPM.

Other equilibrium asset pricing models, such as the Black CAPM model or the model by Hong and Sraer (2016) deliver predictions about equilibria that overcome the low beta bias inherent in the SL CAPM. The AER could replace its core model with one of these. However, this is not necessary. All the AER needs to do is make some adjustment for the imperfections of the CAPM. This is what the AER did in 2013.

In 2015, the Australian Competition Tribunal discussed downward bias.[46] Key points from its discussion are presented below:

- In considering the rationale for the Black CAPM compared to the SL-CAPM, the Tribunal observed (at paragraph 661):

  The AER considered that the Black CAPM relaxes one of the key assumptions of the SL CAPM, namely the assumption that investors can borrow and lend unlimited amounts at the risk free rate. It is accepted that

[44] Partington, G., and Satchell, S., *Report to the AER: Cost Of Equity Issues - 2016 Electricity And Gas Determinations*, April 2016, page 40.
[45] AER, *Draft rate of return guidelines explanatory statement*, July 2018, page 286.
[46] Australian Competition Tribunal, *Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] ACompT 1.*

this leads the SL CAPM to underestimate the return required for low-risk investments.

- At paragraph 726, the Tribunal, in addressing the applicants' (ultimately unsuccessful) challenge to the AER's use of the SL CAPM as a foundation model, observed:

  …other material exposed the risk of bias where the entity concerned has an equity beta of less than 1. The AER was alert to that.

- Then at paragraph 731:

  It is, as the AER noted, correct that the three parameters for the SL CAPM – equity beta, risk free rate, and MRP are recorded as giving a low beta bias for businesses with a beta (that is, the risk of the asset relative to the average asset) of less than 1.0, and that the Network Applicants are all within that group. There was also evidence that the low beta bias is exacerbated when it is combined with conditions of low government bond rates and a high MRP. Those conditions were applicable at the time of the AER Final Decisions. The AER at p 3-240 of Attachment 3 to the Ausgrid Final Decision concluded that "notwithstanding potential limitations with the model, we consider that our implementation of the model recognises any potential empirical limitations.

- The Tribunal also addressed in detail a submission from PIAC that the AER had erred by setting beta too high. The Tribunal made the following observations, consistent with an acceptance of low beta bias (at paragraphs 772 and 779, emphasis added):

  The Tribunal has accepted that, in principle, the AER was entitled to adopt the process as laid out in the RoR 2013 Guideline. Indeed, PIAC's submissions support that, including the use of the foundation model concept and the selection of the SL CAPM as the foundation model. Once the AER, on that basis (and reasonably in the view of the Tribunal) selected a provisional range of 0.4-0.7 for equity beta, it was also entitled to have regard to the expert advice that the SL CAPM had, in the circumstances, a low equity beta bias. It was entitled to have regard to other models, and a range of other data. Indeed, it was required to do so.

  ….

  As with the submissions of Networks NSW, supported by the Vic/SA Interveners and Ergon (although differently focused), the Tribunal can readily understand PIAC's reasons for urging error on the part of the AER. However, for much the same reasons, it has not taken the step of concluding that the AER was in fact in error in finding that the proper point estimate was 0.7 for equity beta. There are reasons why it might have chosen another point estimate. But the Tribunal accepts that the AER was entitled to start with a range. Upon reviewing the whole of the material before the AER, the Tribunal however is not satisfied that that material

> *does not support a conclusion that the SL CAPM provided a low equity beta bias. When, therefore, it comes to the selection of a point estimate, and having regard to the range of data available to the AER, the Tribunal must consider whether it is satisfied of the correctness of an alternative to that adopted by the AER. The short answer is that it is not so satisfied.*

A different Tribunal (for DBNGP) found it was open to the ERA not to adjust for low beta bias given the evidence that was then in front of it. However, that evidence was associated only with actual returns, and not the fuller set of evidence which is now before the AER, and which specifically includes evidence using expected returns. Moreover, the ERA itself did not firmly close the door on new evidence, noting only (para 436 of DBP FD App4):

> *The Authority has concluded that, if any adjustment could be justified, it should apply to the intercept term in the SL-CAPM, thereby taking account of the alpha term arising in ex post tests of the model. However, the Authority is not convinced there is adequate evidence, at the current time, to justify making such an adjustment.*[47]

Low beta bias – recommendations

We recommend the AER adopts an expected equilibrium framework. Having done that, based on the clear and accepted evidence associated with low beta bias in expected as well as actual returns, the AER should then adjust the SL CAPM to account for its imperfections. Put simply, the AER should not retreat from the position it held in 2013, which took account of these imperfections.

We agree with the Independent Panel's finding[48] that, whatever adjustment the AER makes, the adjustment should be made in the SL CAPM rather than beta – as it is not the beta itself that is biased There are several options the AER may take to adjust for bias. One approach is to add an 'alpha' adjustment as a pragmatic solution, and one that the Independent Panel appears to support. Alternatively, we consider an adjustment mechanism similar to that applied in the 2013 Guideline would suffice.

The key question remains how much adjustment should be made. In forming this judgement, the AER will need to consider issues such as:

- the evidence provided by Frontier makes it very clear that the size of the bias is statistically significantly different from zero. This requires an adjustment from any best statistical estimate;
- it is generally agreed that regulated utilities are relatively low risk, which would suggest some caution in making large adjustments if the best statistical estimate of beta is already relatively close to one; and
- the sample size for estimating beta in Australia is small, and the resultant estimates are highly imprecise.

[47] ERA, *Final Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline 2016 – 2020, Appendix 4*, June 2016, paragraph 436.
[48] *Independent Panel Review of the AER's Rate of Return Draft Guidelines*, 7 September 2018, page 27.

Over time, if estimates of beta increase towards one, particularly within a small sample set, any adjustment for issues such as low beta bias would be relatively small. However, similarly, the fact of this evidence of low beta bias would suggest caution is required before making substantive adjustments downwards in the allowed return on equity by, for example, moving substantively away from the top end of a range for beta. In any event, it is certainly the case that the prevailing market conditions and evidence suggests a beta estimate below 0.7 is not justified.

Return on equity cross checks – observations

The AER sets out five cross checks it applies to test the reasonableness of the proposed 3.6 per cent equity risk premium (ERP). Four of those cross checks involve a comparison of the 3.6 per cent figure with other numerical estimates of the equity risk premium. The proposed allowance fails every one of those cross checks. Indeed, the lower band of the range for each alternative estimate is higher than 3.6 per cent.

The fifth cross check compares the difference between the allowed ERP and the debt risk premium (DRP) observed at two points in time. Of the five cross checks, the DRP test is the only one that shows the 3.6 per cent ERP estimate to be reasonable. Even then, it is only reasonable based upon the AER's own interpretation of that evidence when, arguably, that test too shows the result to be unreasonable.

ERP/DRP cross check

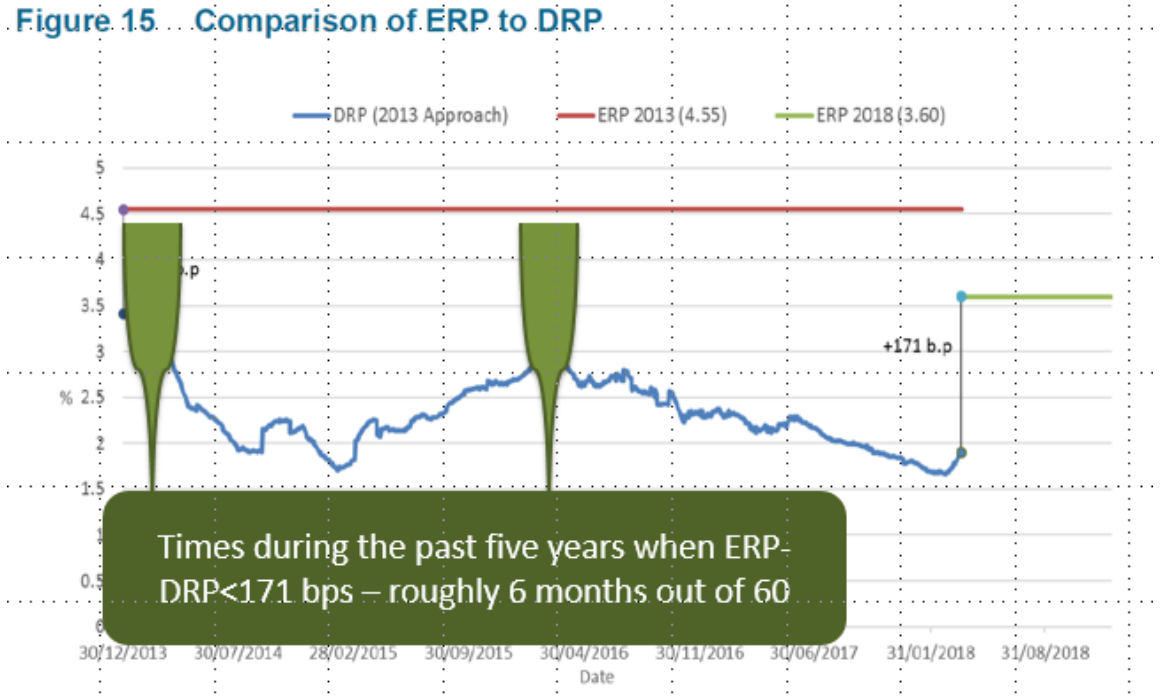
Notwithstanding four out of five cross checks show the AER's ERP estimate to be unreasonable, we recommend the DRP cross check should not be used to justify the ERP because:

- the AER has previously argued against applying this cross check[49];
- the AER's consultants have advised the relationship between ERP and DRP is not stable;[50] and
- a comparison between a DRP at a high point in the cycle (2013) which subsequently fell with what appears to be a DRP at a low point in the cycle (2018) which appears to be rising is misleading when in fact the current difference is greater than the difference during 90 percent of the five years from 2013 when the AER was using its previous ERP (see the AER's Figure 15, reproduced below with the periods in which the difference between ERP and DRP is smaller than it currently is)

[49] AER, *Rate of Return Guideline: Explanatory Statement: Appendices,* December 2013, page 95. AER, *Final decision: Access arrangement final decision: APA GasNet Australia (Operations) Pty Ltd 2013-17, Part 3*, March 2013, page 48.

[50] McKenzie, M., and Partington, G., *The relationship between the cost of debt and the cost of equity*, March 2013, page 10.

Figure 15 Comparison of ERP to DRP



We also submit further expert advice from HoustonKemp (S. Wheatley)[51] (attached at Appendix C) that demonstrates the relationship between the ERP and DRP is not as straightforward as the AER assumes.

The relationship between the ERP and DRP is grounded on the fact that debt and equity are both options on the same underlying asset, and equity is equivalent to being *long* (buying a call), whilst debt is equivalent to being *short* (selling a put).[52] If the ERP/DRP relationship is to be used as a cross check, it should account for the way various market factors influence the two relevant options directly (rather than the premia indirectly) and that buying and selling options result in different impacts to the buyer/seller. This is a complex process and, as Wheatley points out, a wide variety of outcomes are possible.

The AER provides no explanation of whether it has accounted for market factors accordingly in its application of the ERP/DRP cross check.

Our observations on other cross checks are summarised below.

The Wright approach

The AER uses the Wright approach to present an MRP range of 5.6 to 10.6 per cent using a range of beta and one MRP (see the AER's Table 21 reproduced below).

[51] HoustonKemp, *The relation between the equity and debt risk premiums*, September 2018.
[52] Strictly speaking, it is equivalent to being long the risk-free bond and short the put. This is explained in more detail in Appendix C.

Table 21 Wright CAPM return on equity (per cent)

AER equity beta estimate	Wright CAPM return on equity based on 10.1 market return	Wright CAPM return on equity based on 12.6 market return
0.4	5.6	6.6
0.8	8.6	10.6

Source: AER analysis.

Notes: Based on a final risk free rate estimate of 2.64 per cent.

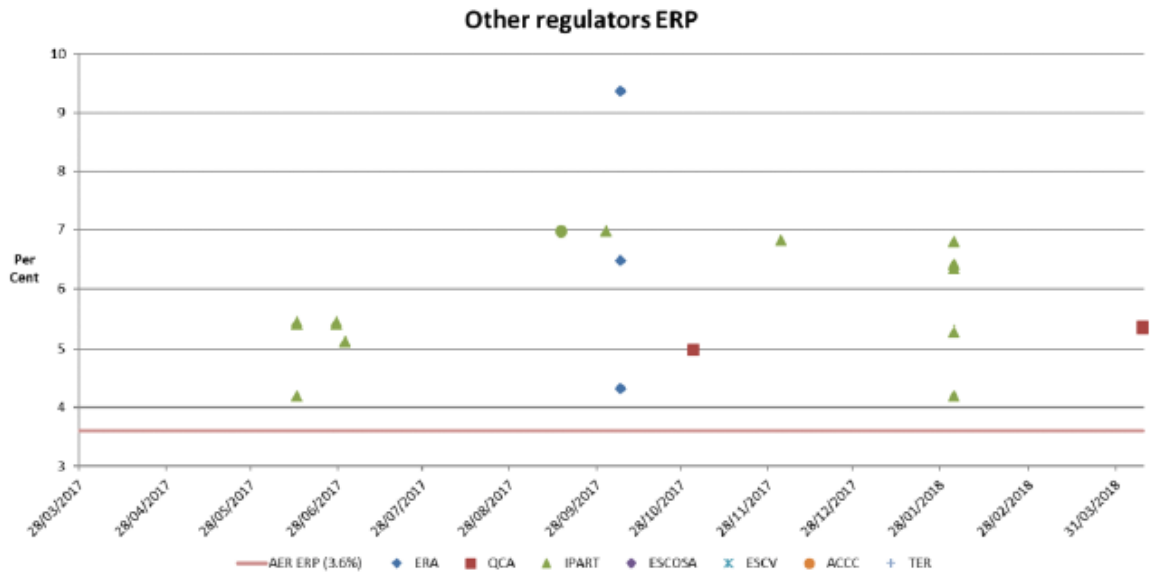
However, the AER has misrepresented the Wright approach. The Wright CAPM is solely a measure of the MRP, it provides no guidance on the reasonableness of equity beta.

Further, given the two measures of the market return (10.1 and 12.6 per cent) and the beta point estimate of 0.6, the range of Wright CAPM return on equity results is 7.1 to 8.6 per cent against an AER allowance of 6.24 per cent (based on a risk free rate of 2.65 per cent). The Wright CAPM is therefore well above the AER's return on equity allowance.

Estimates from other regulators

The AER applies a cross check against the ERPs allowed by other Australian regulators. The results indicate the proposed 3.6 per cent equity risk premium is below that allowed by any regulator in any decision over the relevant period (see the AER's Figure 11 reproduced below).

Figure 11 Equity risk premium estimates from other regulators' decisions



Source: AER analysis of other Australian regulators since 2017

However, the AER gives little weight to this cross check because:

> *…with the exception of the ERA, other Australian regulators do not set revenue determinations for regulated distribution and transmission energy network services.*[53]

This overstates the differences between the price review process and other regulatory determinations.

The AER's Figure 11 does not include the ERA's ERP estimate for Western Power[54], which is 4.20 per cent. Even adjusting for the Western Power estimate being above the five year risk free rate, we estimate the ERP at 3.85 per cent, which is again higher than the AER's 3.6 per cent assumption.

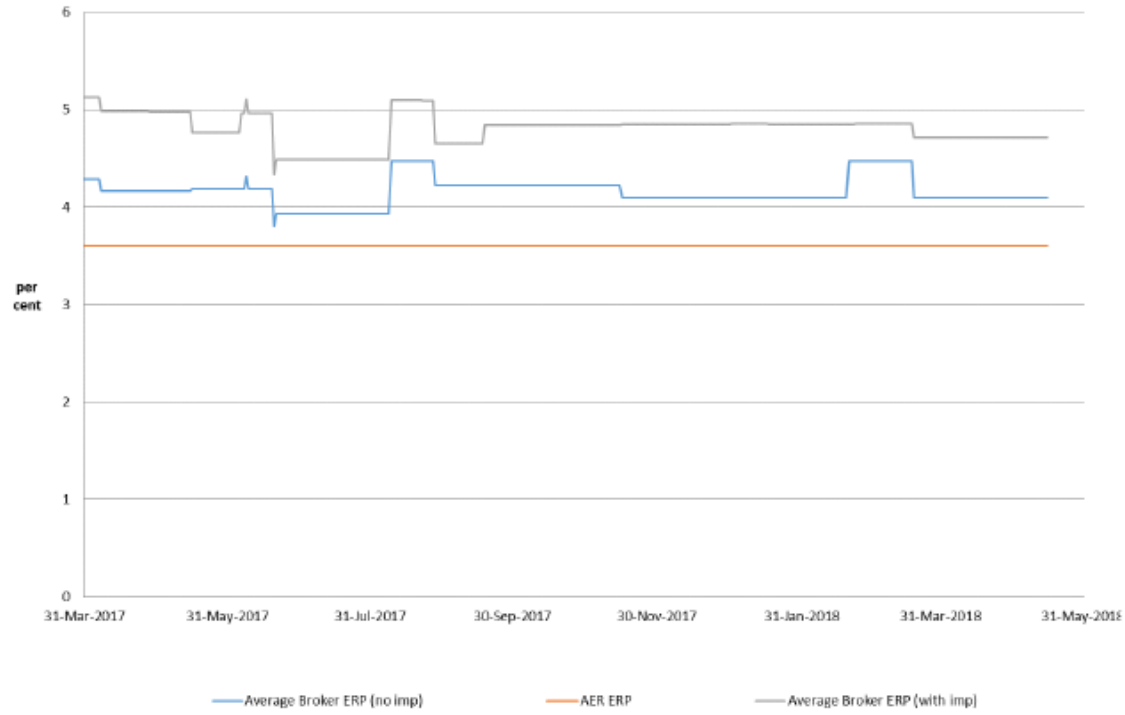
Moreover, the AER does not consider how its decision sits in respect to other regulators around the world. Whilst contexts change with jurisdictions, capital is global, and our investors certainly consider the attractiveness of different regulatory environments when making decisions about where to allocate their capital. In this context, we are aware that the ENA has submitted evidence that the AER is proposing allowed rates of return on equity that are amongst the lowest in the world. We would urge the AER to consider this evidence as it forms its final guideline, and the impact of such an allowance on the attractiveness of Australian energy infrastructure for investment.

Estimates from brokers

The AER uses a cross check against the equity risk premiums used in broker research reports. The AER's Figure 12 (reproduced below) shows the average equity risk premium adopted by brokers has been more than a full percentage point above the proposed 3.6 per cent allowance for the entire period examined by the AER.

[53] AER, *Jemena Gas Networks Final Decision*, Appendix 3, page 39.
[54] Available from: https://www.erawa.com.au/cproot/19491/2/WP%20AA4%20Final%20Decision%20Appendix%205%20-%20Return%20on%20Regulated%20Capital%20Base.PDF page 25-55.

Figure 12 Equity risk premium estimates from broker reports



Source: AER analysis of broker reports that include a valuation for AusNet Services, Spark Infrastructure, APA Group, and/or DUET Group.

Notes: Average broker ERP is the mean of estimates from all brokers and for all businesses available at the time

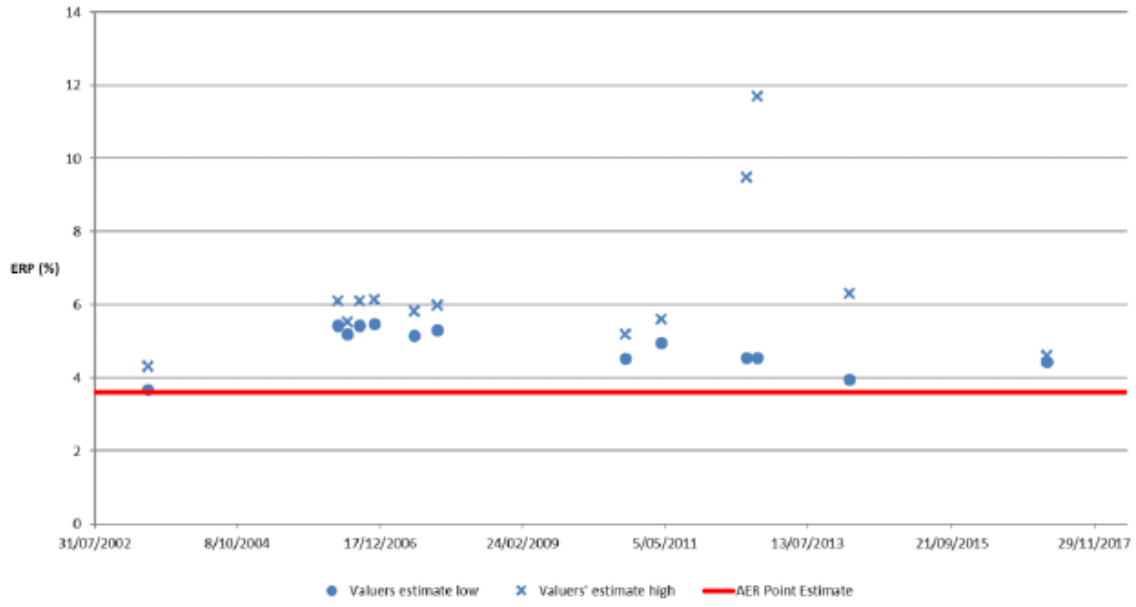
The AER notes its equity risk premium is below the bottom of the unadjusted range (the blue line on Figure 12). However, the *adjusted* range (the grey line on Figure 12) is the true comparator because, like the AER's 3.6 per cent estimate, these adjusted ERP estimates include the value of imputation credits.

In its Explanatory Statement the AER then goes on to present individual *unadjusted* broker estimates, some of which are at 3.5 per cent. The AER implies this validates its 3.6 per cent estimate. However, because these estimates do not include the value of imputation credits, they do not provide an appropriate comparison.

Independent expert valuation reports

Finally, the AER applies a cross check against the ERP used in independent expert valuation reports. As with the broker reports, to allow a direct comparison the independent valuer ERP estimates must include the value of imputation credits. The AER's Figure 14 (reproduced below) presents the results.

Figure 14 Equity risk premium from relevant valuation reports over time



Source: AER analysis of reports from Thomson Reuters

Notes: We have shown the equity risk premium based on a nominal vanilla WACC, expert reports using a different WACC form have been adjusted accordingly. This equity risk premium ('Valuers estimate-high') also reflects the impact of any discretionary uplifts applied by the independent valuer.

As can be seen in Figure 14, the AER's ERP estimate is below all the independent valuer estimates. More importantly, the valuer estimates presented in Figure 14 do not include the AER's assumed valuation of imputation credits, meaning the adjusted valuer estimates would be even higher. It is therefore clear the AER's 3.6 per cent estimate is materially below the ERP used by independent experts.

Return on equity cross checks – recommendations

Given the evidence presented, we recommend the ERP/DRP cross check be given no more weight than the others.[55] If all cross checks are given equal weight, and the ERP fails a majority of them (as occurs with the draft Guideline), the AER should make an appropriate adjustment.

We do not believe any adjustments should be automatic. For example, if the ERP is at the bottom of the range for all cross checks, it should not simply be a case of raising the ERP so it passes the cross checks – as this would mean the cross checks are being given the same weighting as the evidence used to develop the ERP in the first place. This is arguably not the intent of a cross check.

[55] The AER may choose not to depart from its 2013 Guideline, and give this cross check no weight at all.

We suggest that in the event of cross check failure, the AER should return to the initial market-based evidence and re-examine whether the judgement it has applied to that evidence is appropriate.

For example, recent market-based evidence on equity beta suggests the appropriate estimate is around 0.7 or higher. The AER places greatest weight on the longest available dataset, which gives a beta estimate of 0.6. Given the AER's subsequent ERP fails the cross checks, it may be that placing greatest weight the longest dataset is a contributing factor. This should then signal it prudent for the AER to reconsider that judgement and re-examine what other market participants do in respect of a timeframe for the beta estimate. If this investigation suggests using shorter time periods is prevalent, the AER could make a different judgement.

Similarly, it may be disregard of the DGM when forming the MRP that is causing the ERP to fail the cross checks. It may therefore be prudent to re-examine where market participants give regard to forward-looking information, and whether greater weight should be placed on the DGM.

In any event, we are not suggesting any kind of automatic change. Nor do we suggest the cross checks should result in new evidence being used directly to estimate a parameter. Instead, we suggest only that the AER should look to particular instances where it has made a judgement call, and ascertain whether this was the best judgement call to make. This, we consider, is the best way to make use of cross checks.

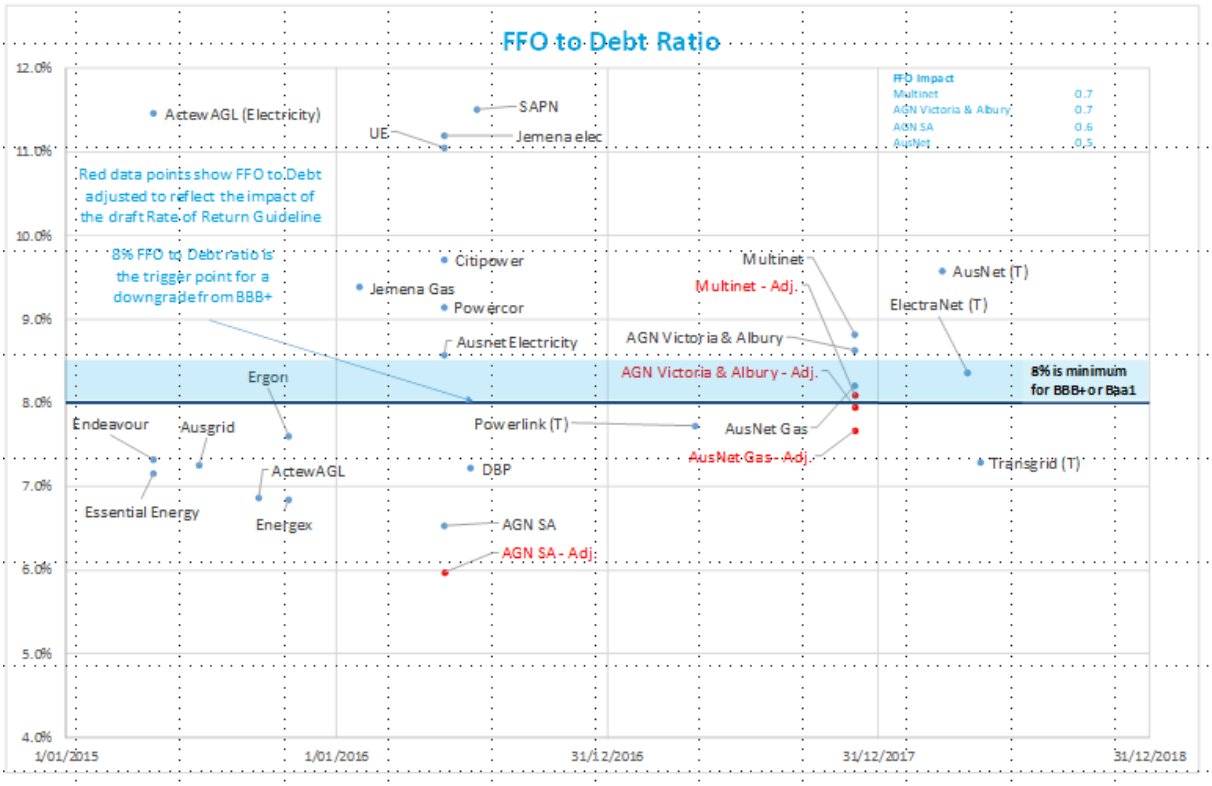
Cost of debt - observations

We understand the AER's estimate of the cost of debt is based upon:

- a ten-year term at issuance for the debt;
- the trailing average approach, with the existing transition mechanism in place;
- the use of the RBA, Bloomberg and Thomson Reuters indices (1/3 A and 2/3 BBB), and not the S&P index.

There is broad acceptance among our members of the BBB+ credit rating and the weighting of the A and BBB bands, noting that gas pipelines have a lower credit rating than the AER's own data suggests.

We would suggest, however, that the AER considers the implications of its proposed rate of return allowances on the credit metrics of the member businesses, as a way of cross checking the sensibility of its results. The following figure is an example of such an analysis.



We have used the PTRM with the draft guideline WACC numbers for a number of regulated entities. As is clear, several of these face the risk of falling below the BBB+ band, which the AER sets as its benchmark. It is also clear that the companies most at risk are generally gas companies.

We accept that credit ratings are not based solely upon FFO/Debt ratios, but these are a core component of ratings as they are one of the few dynamic ingredients to a credit rating. We submit that it would not be in anyone's interest if one consequence of the revised guideline was a credit downgrade consequent upon them being applied to a business at its next regulatory reset.

Cost of debt - recommendations

Despite the broad agreement on the cost of debt throughout the rate of return review process, we note that the Independent Panel has advocated a number of potentially material changes. In particular:

- the Panel concluded the AER should consider the yield curve, and not just an average of ten years;[56]
- the Panel concluded that the AER could make more use of the Chairmont index;[57]
- the Panel concluded that debt averaging periods be made transparent after the period has passed.[58]

[56] *Independent Panel Review of the AER's Rate of Return Draft Guidelines*, 7 September 2018, pages 44, 46-47.
[57] Ibid, page 47.
[58] Ibid, page 30.

Our thoughts on these points are provide below.

Our members have consulted extensively with the AER to reach a conclusion that a ten-year trailing average return on debt is appropriate for setting benchmark return on debt. This provides businesses opportunity to stagger debt over a longer period of time to avoid significant movements in cost of debt due to short term market fluctuations. Given the AER has adopted the use of A data curve along with BBB data curve for measuring the average bond yields, we believe that this will remove any historical outperformance, noting that there is limited or no real outperformance over the *real* return on debt allowance as actual inflation has been significantly below the AER's forecasts.

In respect of the Chairmont index, we defer to the ENA submission. The ENA, through its members, collected the same data that the AER collected, and subjected the Chairmont analysis to independent scrutiny. This was a very useful exercise.[59] The ENA found numerous issues with the analysis done by Chairmont and the AER has been receptive to these issues. We note that not all issues have been resolved, which is perhaps understandable given the index was created for the very first time, and when the cost of debt is in a state of flux due to the transition. This suggests it is prudent not to give any more weight to the Chairmont index until such time there is greater understanding and acceptance. As the Panel itself points out:

> *A particular rate of return does not achieve the national objectives just because finance theory says it should. The national objectives are achieved not by finance theory but by the rational, informed actions of the firms and individuals who comprise the regulated industries: debt investors, equity investors, the managers and employees of regulated firms, consumers large and small, and the practitioners who represent their interests before regulatory tribunals. The Draft Guidelines will be capable of promoting the national objectives only if it wins the trust of, and induces the efficient conduct of, all those parties.*[60]

With regard to the final point on the confidentiality of debt averaging periods, in practice, many businesses use the same (or very similar) averaging periods each year. Thus, if a pattern of three identical averaging periods were observed, it would be fairly simple for the market to predict the next period and act accordingly. We suggest a stronger case needs to be made before making this change.

While we agree entirely with the Independent Panel's broader assertion that the AER's methods and inputs should be transparent such that they can be replicated, in this instance, publishing traditionally confidential information would be to the broader detriment of the market.

[59] Note that APGA did not collect similar data from its own members, but, since most of its members also submitted data through the ENA process, in this instance, the position of gas has been incorporated.
[60] *Independent Panel Review of the AER's Rate of Return Draft Guidelines*, 7 September 2018, page 67.

Gamma – observations

Gamma has been the subject of considerable focus by the AER (and stakeholders more generally) in recent years. After being one of the historically more stable (and certain) inputs to the rate of return estimate, since 2013 regulators and economic experts have reached varying conclusions on the appropriate gamma estimate (typically 0.25 or 0.4), and the issue was also debated through several Australian Competition Tribunal decisions, whereby different Tribunals reached different conclusions using essentially the same data.

This is symptomatic of the difficulty in producing an accurate gamma estimate. Estimates of 0.25 and 0.4 both have merit; highlighting the degree of subjectivity and interpretation that can be applied to the data used to determine the distribution and utilisation rates that comprise gamma, particularly when there is no theoretical grounding to the approach.[61]

In January 2018, the Full Federal Court upheld the AER's decision[62] on gamma for a value of 0.4. We accept this estimate and submit that a gamma of approximately 0.4 is reasonably reflective of a benchmark efficient entity at this time. Perhaps more significantly, we welcome a return to some degree of consistency and certainty in the gamma estimate.

Where we disagree with the AER's approach in its draft Guideline is both in its production of yet more information which it suggests might be relevant to gamma, and also in the need to vary from the 0.4 estimate that has been established.

The AER has revisited the gamma debate, placing more weight on the Lally top 20 ASX-listed firms approach to estimating the distribution rate, in light of doubts about the reliability of ATO statistics. The AER also gives greater weight to the equity ownership approach to estimating the utilisation rate, using ABS data, and now gives sole weight to all equity estimates within that form of evidence. The outcome is that the AER considers gamma is now 0.5 - the product of a distribution rate of 0.83 and a utilisation rate of 0.6.

However, we submit that the change in weighting on the various distribution and utilisation rate inputs is not merited. We consider that Lally's updated top 20 ASX-listed firms estimate is no more conclusive than the information that preceded it, and that the AER has disregarded its shortcomings. The ATO has also clarified that the concerns relating to taxation statistics is confined to franking account balances only. Further, we consider that the AER's move to place greater weight on ABS data is also not justified, particularly given there remain question marks over the quality of the ABS data used to construct equity ownership estimates.

Given the time and energy exhausted in recent years on determining that gamma is 0.4, we question whether varying from this estimate is necessary or is actually a more robust estimate. We submit that a more pragmatic approach would be to maintain the currently accepted position that gamma is 0.4 until there is compelling evidence that finance theory or market conditions necessitate a change.

[61] As experts have agreed is the case for the current AER framework. See Cambridge Economic Policy Associates, *Expert Joint Report*, 21 April 2018, pages 69-70.

[62] Federal Court of Australia, *SA Power Networks v Australian Competition Tribunal (No 2) [2018] FCAFC 3,* Jan 2018.

With regard to the new Lally evidence and the merits of ABS and ATO data utilisation rates, we consider there remain weaknesses in all three. The imprecision in estimating gamma remains and there has certainly not been sufficient evidence to merit a move away from the status quo. Our observations on the ATO and ABS data, and the Lally estimate are below.

ATO and ABS data

The AER states that when determining the utilisation rate of gamma, it gives most weight to the equity ownership approach that uses the ABS data, and less reliance on ATO statistics. Our understanding is that the primary cause for reducing the weighting its places on tax statistics is a statement provided by the Australian Taxation Office (ATO) in a note to the AER in May 2018, saying:

> The ATO would not recommend using Taxation Statistics data as the basis of a more detailed macro analysis of Australia's imputation system.[63]

We understand a statement of this nature would give cause to challenge the value of taxation statistics as an input to estimating gamma, however, the ATO has since clarified its meaning.

On 21 June 2018, the AER and Electricity Networks Association (ENA) met with the ATO to understand what the ATO's above quote means. In that meeting, ATO staff explained that their concerns related primarily to the problems with franking account balance (FAB) data. It was subsequently agreed that the FAB data should not be used and that the dividend data should be used to estimate credits distributed. There is agreement that the problematic FAB data should not be used for any purpose.

FAB data are not required to provide a utilisation estimate of gamma. The inaccuracy of FAB data is therefore not a valid reason to devalue broader taxation statistics from gamma estimates.

We do not propose using taxation statistics provides the perfect answer. Like all datasets used to estimate gamma - including ABS data - the ATO data are not without flaws. However, as Hathaway (2018)[64] concludes, there are no outstanding questions on the quality of the ATO's data on credits created and credits redeemed and that these provide a reliable estimate of the utilisation or cash flow gamma, albeit one that includes unlisted firms.

We therefore submit taxation statistics should be weighted no lower than other complementary datasets such as ABS data.

With regard to the greater weight now being placed on ABS data, given the AER has discredited ATO data based on quality concerns, it follows that ABS data should be

[63] ATO note to the AER regarding imputation. Available at: https://www.aer.gov.au/system/files/ATO%20Note%20to%20AER%20regarding%20imputation%20-%209%20May%202018.pdf

[64] Available at: https://www.aer.gov.au/system/files/Energy%20Networks%20Association%20-%20submission%20on%20rate%20of%20return%20issues%20paper%20-%2012%20December%202017%20-%20Attachment%20C%20-%20Letter%20-%20Dr%20Neville%20Hathaway%20-%20Tax%20Statistics.pdf.

approached with similar caution. The ABS itself has expressed the poor quality of the data used to construct equity ownership estimates:

> *The estimated market value of equity issued by some sectors is considered to be of poor quality. In particular, estimates of the market value of the amount issued by private corporate trading enterprises are considered poor because they are largely built up from counterpart and other information obtained from ABS Surveys of Foreign Investment and Balance Sheet Information. This sector covers equity issued by both listed and unlisted private corporate trading enterprises, of which there are over half a million.*
>
> *In terms of the analysis undertaken here, errors in the estimated market value of equity on issue will impact on the accuracy of estimates of the proportion of that equity owned by non-residents.*
>
> *A further concern relates to valuation. While both financial accounts and international investment statistics (from which the rest of the world data are sourced) are on a market value basis in principle, collection and estimation methods differ between the two sets of statistics…Because of the differences in the methodologies used, it is possible that there could be more variability in the market value estimates of equity held by the rest of the world than in the estimated market value of the equity on issue, thus causing some variation in the foreign ownership series derived from these data.*[65]

Moreover, in recent advice to the ERA, Lally concurs that the ABS data should be assessed.[66] While Lally believes ABS data are preferable to ATO data, he recognises that ABS data require more scrutiny and challenge.

Based on this advice, combined with the recent clarification on the veracity of the ATO data, we recommend the AER reconsiders whether it is prudent to rely heavily on the ABS-based equity ownership approach in place of the taxation statistics. Both the ABS and ATO datasets provide useful information but both are imperfect. This means both datasets should be considered to ensure the gamma picture is more complete, but one should not necessarily be given significantly greater weight than the other.

Lally top 20 ASX-listed firms estimate

When determining the distribution rate, the AER advises it is changing its approach from the 2013 Guideline by now placing primary weight on an estimate by Lally based on the top 20 ASX-listed firms' financial reports. We observe two issues with this approach.

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[65] See the ABS feature article that first explains the foreign ownership calculations at: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/5306.0Feature%20Article150Jun%201992?opendocument&tabname=Summary&prodno=5306.0&issue=Jun%201992&num=&view=.

[66] Lally, M, 2018, *Review of Gamma Submissions and the ERAWA's Views On Gamma*, page 17, available at: https://www.erawa.com.au/cproot/19392/2/D191373%20%20ERAWA-2018-Review%20of%20Gamma%20Chapter%20and%20Submissions%20final.pdf.

Firstly, the Lally estimates are derived from franking account balances - a comparison of the change in FABs over a period to dividends paid over the corresponding period. The 20-firms approach assumes all reductions in the FAB relate to credits being distributed to shareholders. However, material reductions occur for other reasons. Consequently, this approach should only be used as an upper bound and not a point estimate.

Secondly, we submit that the top 20 ASX-listed firms are not appropriate comparators for the benchmark efficient entity. Many of the 20 firms are banks and most of the firms have material foreign profits. The benchmark efficient entity is assumed to operate wholly within Australia and has no foreign profits; it is also not assumed to be a bank.

We consider the unreliability of the data sample does not support the AER moving away from the 2013 Guideline and primary weight on the Lally estimate.

Gamma – recommendations

In conclusion, we see insufficient evidence to support a change in the AER's overall gamma estimating method at this time, and question the reasonableness of doing so.

The Australian Competition Tribunal views the estimate of gamma as an *ongoing intellectual and empirical endeavour*.[67] Expert opinions and evidence on the reliability (or rather the degree of unreliability) of the various approaches to estimating gamma rate are fluid, and even the AER's latest estimating method can just as easily result in a gamma estimate greater or less than 0.4.

We therefore propose the pragmatic solution is to retain gamma at 0.4, and not to re-litigate the issue until further work and more compelling evidence that justifies a diversion from this point estimate is merited.

[67] Australian Competition Tribunal, *Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9*, 12 May 2011, paragraph 45.

APPENDIX A:

HoustonKemp, *Australian estimates of the equity beta of a gas business*, September 2018

HOUSTONKEMP
Economists

Australian estimates of the equity beta of a gas business

A Report for the APGA

September 2018

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Disclaimer

Contents

Figures

Tables

Executive summary

The Australian Energy Regulator (AER) released its draft rate of return guideline on 10 July 2018. In the draft guideline, the AER cuts the equity betas of both the electricity and gas firms that it regulates from 0.7 to 0.6.[1] Thus the regulator does not accept the contention of the Australian Pipelines and Gas Association (APGA) that the equity beta of a gas business should not fall below 0.7.[2]

The APGA has asked HoustonKemp to use the nine Australian regulated energy utilities that form the AER's comparator set and the three periods that the AER examines in its 2017 staff study to:[3]

- provide an estimate of the equity beta of an Australian gas business in each period; and
- test whether each estimate falls significantly below 0.7.

Of the nine firms, three of the firms have operated in the past solely as gas businesses, one operates and has operated in the past almost exclusively as an electricity business while five firms operate or have operated both electricity and gas businesses and in one case a foreign water utility. We use the segment information that listed firms are required to report as notes to their annual financial statements to gauge the proportions of the value of each of the firms that the gas and electricity businesses, which the firms may operate or may have operated, represent. With this information and:

- the ratio of the book value of debt to the market value of equity for each firm;
- the price of a share of each firm's stock, adjusted for capitalisation changes and dividends; and
- the accumulation index for the S&P/ASX All Ordinaries,

we are able to construct re-levered estimates of the equity beta of an Australian gas business and to test whether the estimates fall significantly below 0.7.

Securities

We begin by using the classifications that the AER provides for the nine comparators and re-levered estimates of the equity betas of the nine comparators that the AER delivers to compute the average equity beta estimates for firms that the AER deems to operate solely gas businesses.[4]

The AER estimates suggest that the equity beta of a firm that operates solely gas businesses lies:

- *significantly above* 0.7 in the five-year period ending in April 2017;
- *marginally above* 0.7 in the period that runs from May 1992 to April 2017; and
- *marginally below* 0.7 in the period that begins after the tech boom and excludes the global financial crisis.

The AER, however, does not provide information that allows one to determine whether differences between the estimates and 0.7 are statistically significant. So we update the AER's results to August 2018 and

[1] AER, *Draft rate of return guidelines: Explanatory statement*, July 2018, page 17.

[2] APGA, *Submission to the AER: Review of rate of return guideline*, 4 May 2018, page 4.

[3] AER, Staff beta analysis, June 2017.

[4] AER, *Staff beta analysis*, June 2017.

compute the statistics necessary to infer whether the differences, like those extracted from the AER's results, are statistically significant.

We find that:

- an estimate of the equity beta of a firm that operates solely gas businesses lies *above* 0.7 in the five-year period ending in August 2018 but the difference between the estimate and 0.7 is not significant at conventional levels;
- an estimate of the equity beta of a firm that operates solely gas businesses lies *marginally below* 0.7 in the period that runs from May 1992 to August 2018 but the difference between the estimate and 0.7 is not significant at conventional levels; and
- an estimate of the equity beta of a firm that operates solely gas businesses lies *marginally above* 0.7 in the period that begins after the tech boom and excludes the global financial crisis but the difference between the estimate and 0.7 is, again, not significant at conventional levels.

Portfolios

While these results are interesting, they do not provide a clear guide as to what is the equity beta of a firm that operates solely gas businesses. This is because only two of the nine comparators that the AER uses could be described as having always been solely gas businesses.[5] To provide a guide, we use the segment information that we collect from the annual reports of the nine comparators to form a portfolio designed to be a pure play gas portfolio. Prior to December 2005, we form a pure play gas portfolio as an equally weighted combination of firms that operate only gas businesses. From December 2005 – when the first predominantly electricity business started to trade – we form a pure play gas portfolio by using firms that are predominantly electricity businesses to strip out the electricity operations of firms that are predominantly but not solely gas businesses.

We use the returns to this pure play portfolio to estimate the equity beta of a firm that operates solely gas businesses and to test whether the equity beta falls below 0.7, once more computing estimates for the three periods that the AER considers.

We find that:

- an estimate of the equity beta of a firm that operates solely gas businesses lies *above* 0.7 in the five-year period ending in August 2018 but the difference between the estimate and 0.7 is not significant at conventional levels;
- an estimate of the equity beta of a firm that operates solely gas businesses lies *below* 0.7 in the period that runs from September 1997 onwards and the difference between the estimate and 0.7 is significant at conventional levels; and
- an estimate of the equity beta of a firm that operates solely gas businesses lies *below* 0.7 in the period that begins after the tech boom and excludes the global financial crisis but the difference between the estimate and 0.7 is not significant at conventional levels.

Since the estimates differ markedly across the three periods, we also test whether the equity beta of a pure play gas portfolio is higher today than it has been in the past. We find that an estimate of the equity beta of a pure play gas portfolio that uses data solely from the last five years is, at conventional levels, significantly higher than estimates that use data solely from periods prior to the last five years.

[5] These two comparators are Envestra and GasNet.

Beta is a relative measure of risk. So this result may not be entirely due to changes in the characteristics of a pure play gas portfolio. The result may reflect, at least in part, a change in the characteristics of the market portfolio.

Regardless, overall, our results indicate that there is no evidence from recent data that the equity beta of a pure play gas portfolio sits below 0.7 and what evidence there exists from earlier data relies on the use of data from the tech boom and the global financial crisis.

1. Introduction

The Australian Energy Regulator (AER) released its draft rate of return guideline on 10 July 2018. In the draft guideline, the AER cuts the equity betas of both the electricity and gas firms that it regulates from 0.7 to 0.6.[6] Thus the regulator does not accept the contention of the Australian Pipelines and Gas Association (APGA) that the equity beta of a gas business should not fall below 0.7.[7]

The APGA has asked HoustonKemp to use the nine Australian regulated energy utilities that form the AER's comparator set and the three periods that the AER examines in its 2017 staff study to:[8]

- estimate the equity beta of an Australian gas business; and
- test whether each estimate falls significantly below 0.7.

Of the nine firms, three of the firms have operated in the past solely as gas businesses, one operates and has operated in the past almost exclusively as an electricity business while five firms operate or have operated both electricity and gas businesses and in one case a foreign water utility. We use the segment information that listed firms are required to report as notes to their annual financial statements to gauge the proportions of the value of each of the firms that the gas and electricity businesses, which the firms may operate or may have operated, represent. With this information and:

- the ratio of the book value of debt to the market value of equity for each firm;
- the price of a share of each firm's stock, adjusted for capitalisation changes and dividends; and
- the accumulation index for the S&P/ASX All Ordinaries,

we are able to construct re-levered estimates of the equity beta of an Australian gas business and to test whether the estimates fall significantly below 0.7.

The rest of the report is organised as follows:

- section 2 describes the data that we use; and
- section 3 provides empirical results.

In addition:

- Appendix A1 provides an analysis of the differences between LAD and OLS regressions;
- Appendix A2 describes how we handle missing observations;
- Appendix A3 provides the terms of reference for this report; and
- Appendix A4 provides the curriculum vitae of the author of the report.

[6] AER, *Draft rate of return guidelines: Explanatory statement*, July 2018, page 17.

[7] APGA, *Submission to the AER: Review of rate of return guideline*, 4 May 2018, page 4.

[8] AER, Staff beta analysis, June 2017.

Statement of credentials

This report has been prepared by **Simon Wheatley**.

Simon Wheatley is a Special Adviser to HoustonKemp and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his finance expertise in consulting and investment management outside the university sector. Simon's interests and expertise are in how assets are priced. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington.

2. Data

To estimate the equity beta of a firm that operates solely gas businesses, we use, for each of the AER's set of nine comparator firms:

- segment information;
- the ratio of the book value of debt to the market value of equity; and
- the price of a share of the firm's stock, adjusted for capitalisation changes and dividends.

We also use:

- the accumulation index for the S&P/ASX All Ordinaries.

The equity beta of a firm will be a weighted average of the equity betas of the segments in which the firm operates – where the weights are the proportions of the market value of the firm that the operations represent. While, for each operation, one cannot observe directly the proportion of the market value of the firm that the operation represents, one can extract information that can be useful in estimating the proportion from annual reports that the firm issues. In particular, one can extract information from the segment disclosures that firms are required to make in the notes to their financial statements.

2.1 Segment reporting

Firms that are listed on organised exchanges are required to provide segment information in the notes to their financial statements. These disclosures can provide information on the risks facing a firm that aggregate data may not be able to provide. The rules governing what form this information should take have changed over time and in what follows we briefly explain how the rules have evolved.

2.1.1 AASB 1005

Australia's original segment standard AASB 1005, released in 1986, required listed companies to disclose segment revenue, segment result and the carrying amount of segment assets and liabilities for both industry and geographical segments for financial years ending on or after 30 June 1986. The standard was subsequently revised in 2000 to require each firm to use its internal organisational structure and reporting system to identify segments – unless the reporting system was not based on industrial or geographical segments, in which case the entity's segments were to be determined according to the accounting standard.[9] The revision also required each firm choose one basis of segmentation, be it industrial or geographical, as being primary and the other secondary, with less information required to be disclosed for secondary segments.

2.1.2 AASB 114

AASB 114, to be used by listed companies for financial years beginning on or after 1 January 2005, differs little from the standard it replaced, AASB 1005.[10] The two primary differences between AASB 1005 and AASB 114 are:

- AASB 1005 specifies that only reportable segments are eligible to be combined whereas AASB 114 does not include this restriction on combining segments; and

[9] Australian Accounting Standards Board, Accounting standard AASB 1005: Segment reporting, August 2000.

[10] Australian Accounting Standards Board, Accounting standard AASB 114: Segment reporting, July 2004.

- AASB 114 requires disclosure of the segment result from continuing operations separately from the result from discontinued operations for each reportable segment. AASB 1005 does not contain this requirement.

2.1.3 AASB 8

The current standard, AASB 8, requires listed entities to provide segment information using the method that management employs in identifying and measuring segment performance for reporting periods beginning on or after 1 January 2009.[11] As with AASB 114 and the later version of AASB 1005, the idea behind the standard is that readers of a firm's financial statements will be provided with information about how the firm's management run their business. Relative to AASB 114, however, AASB 8 reduced the flexibility of managers to restructure their internal segments when reporting externally.

In particular, AASB 8 defines an operating segment to be: [12]

> a component of an entity:
>
> (a) that engages in business activities from which it may earn revenues and incur expenses (including revenues and expenses relating to transactions with other components of the same entity),
>
> (b) whose operating results are regularly reviewed by the entity's chief operating decision maker to make decisions about resources to be allocated to the segment and assess its performance, and
>
> (c) for which discrete financial information is available.
>
> An operating segment may engage in business activities for which it has yet to earn revenues, for example, start-up operations may be operating segments before earning revenues.

and states that:

> An entity shall report a measure of profit or loss for each reportable segment.

and that:

> The amount of each segment item reported shall be the measure reported to the chief operating decision maker for the purposes of making decisions about allocating resources to the segment and assessing its performance.

2.2 Comparators

The AER uses nine Australian firms as comparators in estimating the equity beta of an energy utility. Table 1 below lists the nine firms, the dates on which they were first listed on the Australian Securities Exchange (ASX), where relevant, the dates on which they were delisted and, for each firm, the AER's classification of the firm as being either a gas business, a business with both gas and electricity operations or a business with gas operations and minority interests in other energy infrastructure.

In what follows, we outline how these firms have evolved and what information about the activities that they undertake or have undertaken in the past can be gleaned from the segment information provided in the notes to the financial statements contained in their annual reports. Some of these firms operate or have operated in the past solely as gas businesses, one of the firms operates and has operated in the past almost solely as an electricity business and some of the firms operate or have operated both gas and electricity businesses.

[11] While listed entities were required to use the standard for reporting periods beginning on or after 1 January 2009, they were also permitted to adopt the standard early.

[12] Australian Accounting Standards Board, Compiled AASB standard AASB 8: Operating segments, December 2015.

Table 1: Firms in the AER comparator set

Firm (ASX ticker)	Listing date	Delisting date	AER sector
Alinta (AAN)	17 October 2000	11 October 2006	Gas
AGL (AGL)	1871	11 October 2006	Electricity, gas
APA Group (APA)	13 June 2000		Gas, other energy infrastructure
AusNet (SPN, AST)	14 September 2005		Electricity, gas
DUET Group (DUE)	13 August 2004	1 May 2017	Electricity, gas
Envestra (ENV)	29 August 1997	12 September 2014	Gas
GasNet (GAS)	17 December 2001	14 November 2006	Gas
Hastings (HDF)	13 December 2004	23 November 2012	Gas
Spark Infrastructure (SKI)	1 March 2007		Electricity, gas

Notes: AER sector denotes the AER's description of the sectors in which each company is engaged.
Source: AER, Draft rate of return guidelines: Explanatory statement, July 2018, page 262.

2.2.1 Alinta (AAN)

Alinta Gas was created in 1995 when the State Energy Commission of Western Australia split into separate gas and electricity entities, AlintaGas and Western Power. AlintaGas was subsequently listed on the ASX in October 2000.

A reading of the segment information given in the AlintaGas annual reports of 2000 to 2002 reveals that the firm operated over these years solely as a gas business. In 2003, however, the firm purchased a share in United Energy, the Victorian electricity network service provider and so, to reflect its move into electricity, in May 2003, AlintaGas changed its name to Alinta. In October 2006, Alinta ceased trading on the ASX and merged with the Australian Gas Light Company. The merged company then restructured to form two new listed companies, Alinta and AGL Energy.

Unfortunately, from 2003 to 2006, the segment information provided in Alinta's annual reports reveals how its operations were split between retail and distribution but not how they were split between gas and electricity. For this reason, we confine our use of data on Alinta to the period from the firm's first listing in 2000 to the end of 2002 and we presume that, over this period, the firm – AlintaGas as it then was – was solely a gas business.

2.2.2 Australian Gas Light Company (AGL)

The Australian Gas Light Company was founded in 1837 and was first listed on the Sydney Stock Exchange, a precursor of the ASX, in 1871. While the company first operated as a gas business, it eventually moved into electricity. In 2006 the company merged with Alinta with, as noted above, the merged firm being restructured into two new listed companies, Alinta and AGL Energy.

The segment information provided in AGL's annual reports reveals that in 1996 the company was primarily a gas business operating largely in Australia but that over the next decade the company branched out significantly into other businesses operating not only in Australia but abroad. So by 2006 only 28 per cent of segment profits arose from gas and electricity networks operating in Australia. In many years, one cannot determine what fraction of the profits generated by the firm's other businesses or what fraction of the assets net of liabilities of the businesses could be reasonably viewed as arising from gas operations. Similarly, in many years, one cannot determine what fraction of the profits or what fraction of the assets net of liabilities

could be reasonably viewed as arising from electricity operations. The segment information provided in the notes to AGL's financial statements are not sufficiently detailed. For this reason, we do not use data on AGL.

2.2.3 APA Group (APA)

The Australian Pipeline Trust was registered with the Australian Securities and Investments Commission as a Managed Investment Scheme in March 2000, was subsequently listed on the ASX in June 2000 and in January 2007 restructured as a stapled entity comprising the Australian Pipeline Trust and APT Investment Trust under the name, the APA Group. The company operated solely as a gas business from 2000 to 2005 but purchased interests in Murraylink in 2006 and Directlink in 2007, two electricity interconnectors, and in North Brown Wind Farm in 2009, and purchased Emu Downs Wind Farm in 2011. The company also now has interests in electricity generation plants: the Diamantina and Leichardt power stations and the Daandine and X41 power stations.

From 2002 to 2005, the segment information provided in APA's annual reports indicate that the company operated predominantly in one business segment, gas transmission. From 2006 to 2010, the reports list accounting data for either gas transmission or gas transmission and distribution while from 2011 onwards, the reports list data for energy infrastructure – which incorporates data for some non-gas operations. From 2006 to 2009, the reports list accounting data for electricity transmission and complimentary assets, from 2007 onwards, the reports list data for asset management, from 2008 onwards, energy investments and from 2014 onwards, corporate costs.

The 2015 and 2018 APA annual reports contain graphs that allow one to determine for each year from 2011 to 2018 what fraction of the energy infrastructure earnings before interest, taxes, depreciation and amortisation (EBITDA) was generated by gas operations and what fraction was generated by other operations. In 2011, the fraction generated by non-gas operations was zero while in 2018 it was eight per cent.

Re-levered estimates of the equity beta of APA are relatively high. So, to be conservative, we classify any segment that has positive EBITDA which might conceivably include non-gas operations, generating earnings the magnitude of which we cannot quantify, as a segment that involves solely electricity operations. We classify any segment that has negative EBITDA as a segment that involves solely gas operations. So in addition to electricity transmission we also classify asset management, energy investments, and complimentary assets as segments involving solely electricity operations. We classify corporate costs as being generated solely by APA's gas operations.

Figure 1 below plots estimates of the proportions of the value of APA that its gas and electricity operations represent computed using EBITDA for each segment taken from the firm's annual reports against time. The mean of the gas estimates is 0.91. We also compute estimates of the proportions using assets less liabilities for each segment taken from the firm's annual reports and the mean of the gas estimates is also 0.91.

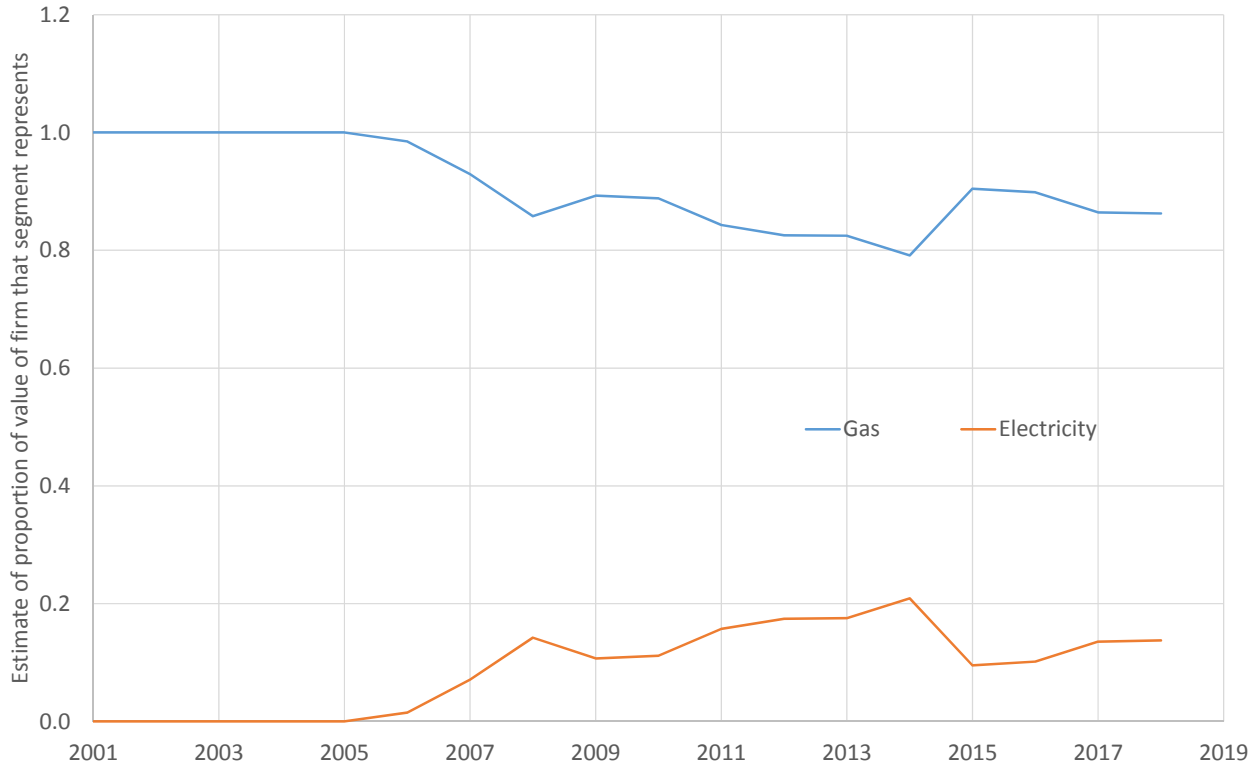
2.2.4 AusNet Services (SPN, AST)

SP AusNet, as AusNet was then known, was listed with ticker SPN on the ASX in December 2005. The name and ticker of the company changed in August 2014 to AusNet and AST. The company currently owns electricity distribution, electricity transmission and gas distribution networks in Victoria and provides energy services to business and government.

We use segment information provided in the notes to AusNet's annual reports to estimate the proportions of the market value of the firm that its gas and electricity operations represent. Using EBITDA, we estimate that over the years 2006 to 2018, electricity operations account on average for 81 per cent of the value of the firm, gas operations account for 17 per cent and other operations account for two per cent. In making these calculations we exclude earnings arising from the sale of the Merchant Energy Business in May 2005. Allocating the proportion of the value of the firm that other operations represent equally between gas and electricity provides an estimate of the proportion of the value of the firm that electricity operations represent

of 82 per cent and an estimate of the proportion of the value of the firm that gas operations represent of 18 per cent.

Figure 1: APA segment data



Note: The figure estimates the proportion of the value of the firm that each segment represents using EBITDA for each segment taken or computed from the notes to APA's financial statements.

Figure 2 below plots estimates of the proportions of the value of AusNet that its gas, electricity and other operations represent computed using EBITDA against time. The figure shows that there is relatively little variation in the estimates across time. We also compute estimates of the proportions using assets less liabilities for each segment taken from the firm's annual reports from 2006 to 2010 and the means of the electricity and gas estimates are also 0.82 and 0.18.

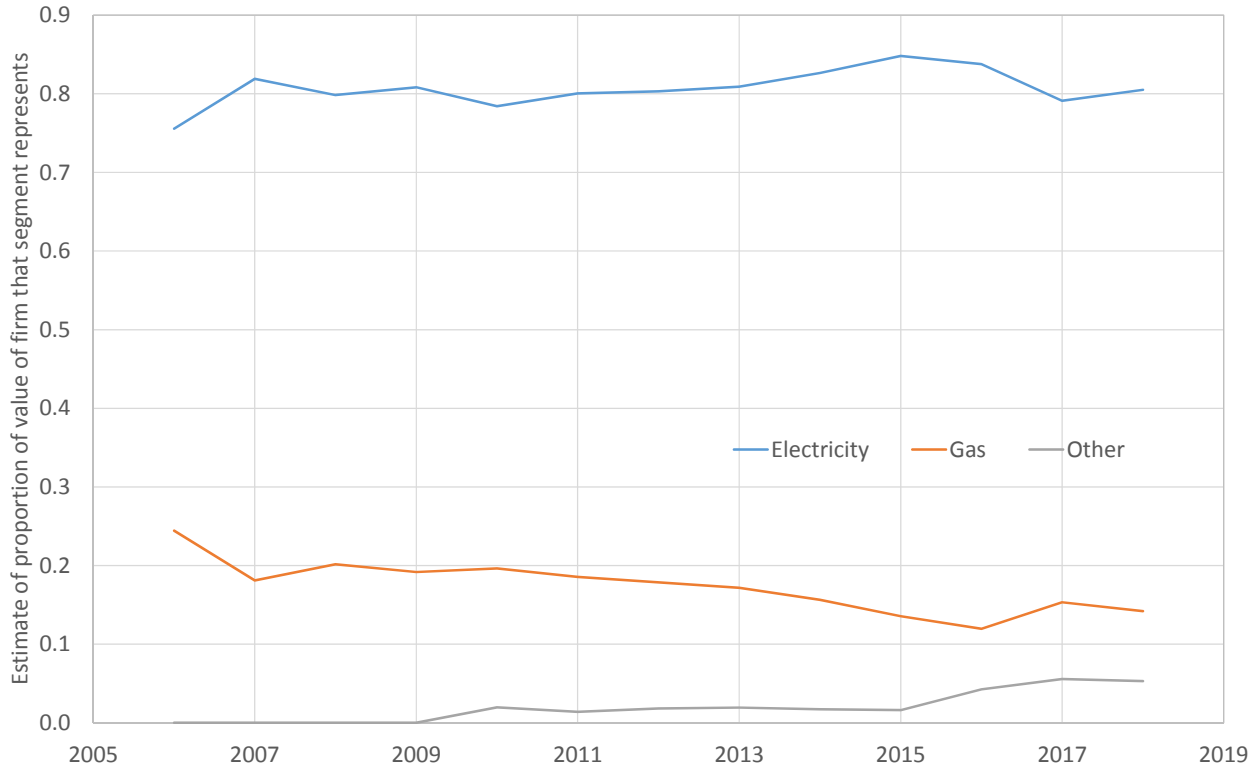
2.2.5 DUET Group (DUE)

DUET was first listed on the ASX in August 2004 but was acquired by a Cheung Kong Infrastructure-led consortium in May 2017 at which time DUET's shares ceased trading. DUET had interests in the Dampier to Bunbury Pipeline, DBP Development Group, Multinet Gas and WA Gas Networks – all Australian gas businesses – and United Energy, a Victorian electricity distributor. In addition, DUET had interests in Duquesne Light, acquired in May 2007 and sold in September 2010, a US electricity distribution and transmission business and Energy Developments, acquired in October 2015, a business that operates in a number of different countries and across a number of different segments.

We use segment information provided in the notes to DUET's annual reports to estimate the proportions of the market value of the firm that its gas and electricity operations represent. Using EBITDA, we estimate that over the years 2005 to 2015, gas operations account on average for 58 per cent of the value of the firm and electricity operations account for 42 per cent. We discard data from 2004 because prior to the purchase of

the Dampier to Bunbury Pipeline In October 2004 DUET could be viewed as a predominantly electricity business and so a different firm than it subsequently became. We exclude data from 2016 because of the difficulty in determining what part of Energy Developments can be viewed as a gas business and what part can be viewed as an electricity business.

Figure 2: AusNet segment data



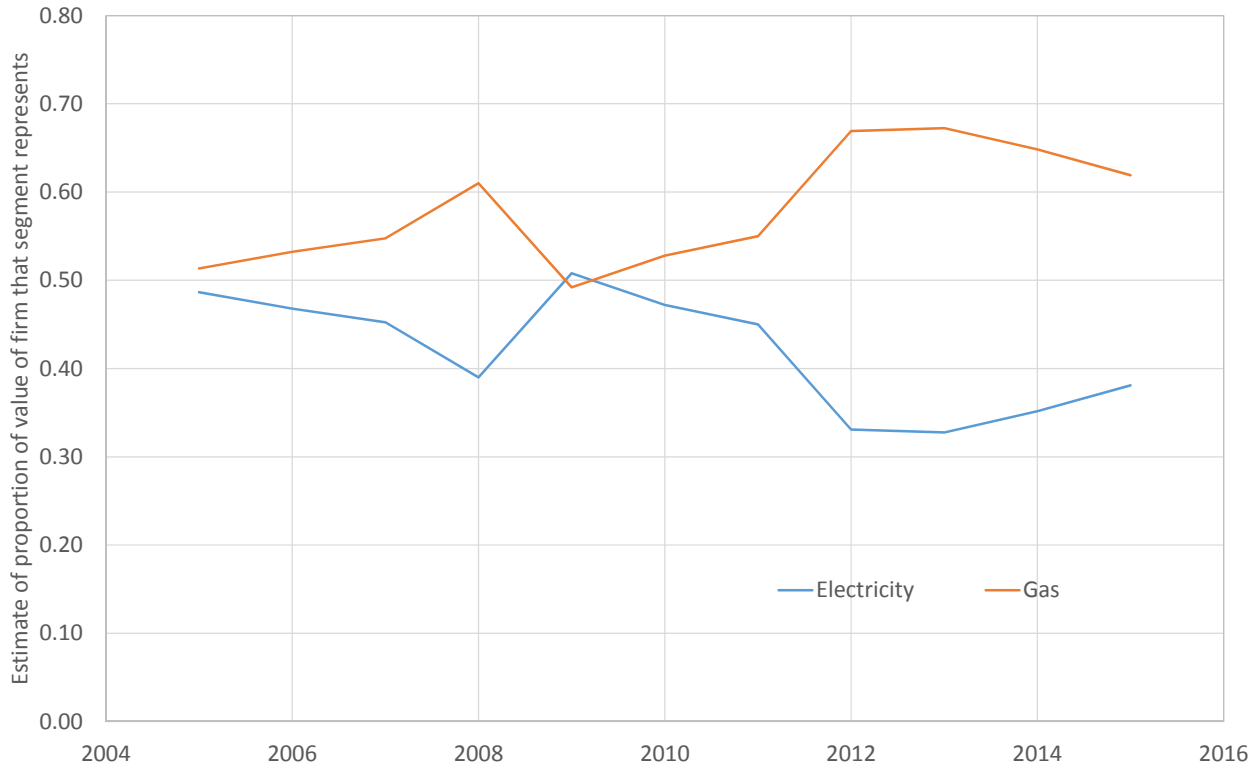
Note: The figure estimates the proportion of the value of the firm that each segment represents using EBITDA for each segment taken or computed from the notes to AusNet's financial statements.

Figure 3 below plots estimates of the proportions of the value of DUET that its gas and electricity operations represent computed using EBITDA against time. The figure shows that there is some variation in the estimates across time. We also compute estimates of each proportion using assets less liabilities for each segment taken from the firm's annual reports from 2005 to 2015 and the means of the gas and electricity estimates are 0.66 and 0.34. In our empirical work we examine the sensitivity of our results to using these alternative estimates but find that our results are not sensitive to their use.

2.2.6 Envestra (ENV)

Envestra was listed on the ASX in August 1997 but was bought by the Cheung Kong Group in September 2014 at which time Envestra's shares ceased trading. Envestra was subsequently renamed Australian Gas Networks. As the firm's new name suggests, the firm operated solely as a gas business. Confirmation that this suggestion is correct is provided by a reading of the segment information provided in Envestra's annual reports for each year from 1998 to 2014, which indicates that Envestra always operated solely as a gas business.

Figure 3: DUET segment data



Note: The figure estimates the proportion of the value of the firm that each segment represents using EBITDA for each segment taken or computed from the notes to DUET's financial statements.

2.2.7 GasNet (GAS)

GasNet was listed on the ASX in December 2001 but was bought by APA in December 2006, the shares of GasNet having ceased trading one month before. As the firm's name suggests, the firm operated solely as a gas business. Confirmation that this suggestion is correct is provided by a reading of the segment information provided in GasNet's annual reports from 2001 to 2005, which indicates that GasNet always operated solely as a gas business.

2.2.8 Hastings Diversified Utilities Fund (HDF)

Hastings Diversified Utilities Fund was first listed on the ASX in December 2004 and ceased trading in November 2012. It was subsequently acquired by the APA Group who renamed the fund the APA Sub Group. As the fund's original name suggests, the fund was diversified across a number of segments.

Hastings held a 100 per cent interest in Epic Energy, which ran three gas pipeline systems: the Moomba to Adelaide Pipeline System, the Pilbara Pipeline System and the South West Queensland Pipeline System. Hastings also held a 50 per cent interest in Mid Kent Water, a British water utility, and, subsequently, a 39 per cent interest in South East Water, another British water utility with which Mid Kent had merged.

Unfortunately, it is difficult to determine from the segment information that Hastings provides in its annual reports what proportion of the value of the firm its gas operations represent. One can infer what proportion they represent, however, from other information provided in Hastings' annual reports, at least from 2005 to 2009. Hastings reports separately, from 2005 to 2009, Epic Energy's EBITDA and Hastings' EBITDA. We

estimate the proportion of the value of Hastings that its gas operations represent, each year from 2005 to 2009, as the ratio of Epic Energy's EBITDA to Hastings' EBITDA. The mean of these estimates across the years 2005 to 2009 is 0.91.

2.2.9 Spark Infrastructure (SKI)

Spark Infrastructure was listed on the ASX in March 2007 and, as the firm's name suggests, operates almost solely as an electricity business. The firm has a 49 per cent interest in Victoria Power Networks which owns CitiPower and Powercor, two Victorian electricity distributors. The firm also has a 49 per cent interest in SA Power Networks, the sole operator of South Australia's electricity distribution network, and a 15 per cent interest in TransGrid, which operates a large electricity transmission network, primarily in New South Wales. In the past, however, Spark Infrastructure has also owned an interest in the DUET Group, which, as we have seen, operates both gas and electricity businesses.

We use segment information provided in the notes to Spark Infrastructure's annual reports to estimate the proportions of the market value of the firm that its gas and electricity operations represent. Using segment results, we estimate that over the years 2007 to 2017, electricity operations account on average for 99 per cent of the value of the firm and gas operations account for one per cent. In making these calculations we make use of the estimates that we compute for the DUET Group. Using data on segment assets net of segment liabilities we also estimate that over the years 2007 to 2017, electricity operations account on average for 99 per cent of the value of the firm and gas operations account for one per cent.

2.2.10 Summary

Table 2 summarises the results of our examination of the annual reports of the nine comparators and provides the estimates of the sector weights that we use in our empirical work together with the periods over which we use the weights.

Table 2: Sector weights computed from information contained in annual reports

Firm (ASX ticker)	Beginning	Ending	Electricity	Gas
Alinta (ALN)	17 October 2000	31 December 2002	0.00	1.00
AGL (AGL)				
APA Group (APA)	13 June 2000		0.09	0.91
AusNet (SPN, AST)	14 December 2005		0.82	0.18
DUET Group (DUE)	1 July 2005	30 June 2015	0.42	0.58
Envestra (ENV)	29 August 1997	12 September 2014	0.00	1.00
GasNet (GAS)	17 December 2001	14 November 2006	0.00	1.00
Hastings (HDF)	1 January 2005	31 December 2009	0.09	0.91
Spark Infrastructure (SKI)	1 March 2007		0.99	0.01

Notes: The sector weights are computed or inferred from information provided by the nine firms in their annual reports. AGL does not provide information sufficient to infer what proportions of the value of the firm its gas and electricity operations represent.

3. Evidence

We examine whether the re-levered equity beta of a gas business falls below 0.7 using both individual securities and portfolios of securities. We begin by examining the results that the AER provides in its *Staff Beta Analysis* of June 2017.

3.1 Individual securities

3.1.1 AER results

The AER produces re-levered estimates of the equity betas of the nine comparators using three periods. The three periods are:

- the longest possible period of data for each firm beginning with 29 May 1992 for AGL and ending on 30 April 2017;
- the longest possible period of data for each firm after the tech boom and excluding the global financial crisis; and
- the most recent five years ending on 30 April 2017.

The AER also uses two methods:

- ordinary least squares (OLS); and
- least absolute deviations (LAD).

The idea behind the use of LAD is that LAD estimates can be less sensitive to extreme observations than OLS estimates. While OLS estimates of the equity beta of a firm will in general be unbiased and consistent, however, LAD estimates can be biased and need not be consistent. For this reason, we do not report LAD estimates. Appendix A1 provides a brief discussion of the difference between OLS and LAD regression.

Table 3 below provides the OLS results that the AER produces and provides averages of the OLS estimates across firms that the AER deems to operate solely gas businesses.[13] While the AER does not provide the information necessary to judge the significance of the averages, the averages for the longer periods do not appear do sit far from 0.7 while the average for the last five years – which is the estimate for APA – sits some way above 0.7.

3.1.2 HoustonKemp results

To assess the statistical significance of the individual security results, we update the results that the AER provides to 17 August 2018 and compute the standard errors of both the individual security estimates and of the averages of the estimates across firms that the AER deems to operate solely gas businesses.

[13] For the purposes of this table and our update of this table, Table 4, we view the APA Group as operating predominantly gas businesses.

Table 3: AER individual equity beta estimates: 1992 – 2017

			OLS estimate for period		
Company	AER sector	Gearing	1	2	3
Alinta	Gas	0.388	0.830	0.947	
			(0.110)	(0.129)	
AGL	Mixed	0.327	0.686	0.706	
			(0.064)	(0.098)	
APA	Gas	0.524	0.722	0.785	0.934
			(0.046)	(0.054)	(0.084)
AusNet	Mixed	0.595	0.399	0.561	0.789
			(0.058)	(0.060)	(0.090)
DUET	Mixed	0.707	0.342	0.377	0.309
			(0.064)	(0.066)	(0.103)
Envestra	Gas	0.696	0.372	0.361	
			(0.072)	(0.062)	
GasNet	Gas	0.643	0.350	0.353	
			(0.117)	(0.117)	
Hastings	Gas	0.450	1.302	0.927	
			(0.139)	(0.087)	
Spark	Mixed	0.632	0.391	0.414	0.484
			(0.065)	(0.074)	(0.094)
Mean gas			0.715	0.675	0.934

Notes: All beta estimates are re-levered to a gearing of 60 per cent. Standard errors are in parentheses below estimates.
Source: AER, Staff beta analysis, June 2017.

The AER estimates the un-re-levered equity beta of a firm using the regression:

$$r_{jt} = \alpha_j + \beta_j r_{mt} + \varepsilon_{jt}, \quad (1)$$

where:

- r_{jt} = the return to the equity of firm *j* from time *t*-1 to *t*;
- r_{mt} = the return to the market portfolio;
- α_j = the regression intercept;
- β_j = the slope coefficient, that is, the equity beta of firm *j*; and
- ε_{jt} = the regression disturbance.

The AER computes an estimate of the re-levered equity beta using the relation:

$$\beta_j^* = \omega_j \beta_j, \qquad \omega_j = \frac{1-G_j}{1-0.6}, \tag{2}$$

where:

β_j^*	=	the re-levered equity beta of firm *j*;
ω_j	=	the re-levering factor for firm *j*;
G_j	=	the gearing of firm *j* – presumed constant through time;

The re-levered equity beta can also be estimated using the regression:

$$r_{jt}^* = \alpha_j^* + \beta_j^* r_{mt} + \varepsilon_{jt}^*, \qquad r_{jt}^* = \omega_j r_{jt}, \quad \alpha_j^* = \omega_j \alpha_j, \quad \beta_j^* = \omega_j \beta_j, \quad \varepsilon_{jt}^* = \omega_j \varepsilon_{jt}, \tag{3}$$

where:

r_{jt}^*	=	the re-levered return to the equity of firm *j* from time *t*-1 to *t*;
α_j^*	=	the regression intercept;
β_j^*	=	the slope coefficient, the re-levered equity beta of firm *j*; and
ε_{jt}^*	=	the regression disturbance;

We use (3) and data drawn from Bloomberg to update the estimates that the AER provides in its 2017 study. We use the All Ordinaries as a measure of the market portfolio and returns that are not continuously compounded while the AER uses the S&P/ASX 300 as a measure of the market and returns that are continuously compounded. We use the All Ordinaries because it is a marginally broader measure of the market and we use returns that are not continuously compounded because the model that the AER employs, the Sharpe-Lintner Capital Asset Pricing Model, uses returns that are not continuously compounded. Not surprisingly, though, despite these minor differences, our results are similar to those that the AER reports.

Table 4 provides our individual security results. The table shows that there is no evidence, using the classifications that the AER provides, that the re-levered equity beta of a firm operating solely gas businesses falls below 0.7. [14]

While these results are interesting, they do not provide a clear guide as to what the equity beta of a firm is that operates solely gas businesses. This is because some of the firms that the AER deems to be gas businesses operate or have operated in the past electricity businesses. For this reason, we form a portfolio designed to be a pure play gas portfolio and use the returns to the portfolio to estimate the equity beta of a firm that operates solely gas businesses.

[14] Computing the standard errors requires that one take into account that some data are missing and Appendix A2 shows how one can do so.

Table 4: HoustonKemp individual equity beta estimates: 1992 – 2018

			OLS estimate for period		
Company	AER sector	Gearing	1	2	3
Alinta	Gas	0.364	0.945	1.087	
			(0.231)	(0.232)	
AGL	Mixed	0.323	0.692	0.678	
			(0.121)	(0.203)	
APA	Gas	0.524	0.699	0.762	0.952
			(0.064)	(0.068)	(0.124)
AusNet	Mixed	0.587	0.396	0.542	0.763
			(0.065)	(0.061)	(0.085)
DUET	Mixed	0.702	0.364	0.378	0.331
			(0.062)	(0.049)	(0.075)
Envestra	Gas	0.705	0.334	0.349	0.460
			(0.048)	(0.049)	(0.182)
GasNet	Gas	0.653	0.339	0.342	
			(0.094)	(0.094)	
Hastings	Gas	0.451	1.057	0.965	
			(0.227)	(0.159)	
Spark	Mixed	0.614	0.432	0.463	0.560
			(0.069)	(0.064)	(0.091)
Mean gas			0.675	0.701	0.827
			(0.072)	(0.065)	(0.101)
			[0.364]	[0.506]	[0.896]

Notes: All beta estimates are re-levered to a gearing of 60 per cent. Heteroscedasticity consistent standard errors are in parentheses while p-values for tests of the null hypothesis that beta is no less than 0.7 appear in brackets.

3.2 Portfolios of securities

Where the data exist, we form a pure play gas portfolio by using firms that are predominantly electricity businesses to strip out the electricity operations of firms that are predominantly gas businesses.

To do this, we begin by forming two equally weighted portfolios:

- a portfolio that is a predominantly gas portfolio, but not a pure play gas portfolio; and
- a portfolio that is a predominantly electricity portfolio, but not a pure play electricity portfolio.

We form these two portfolios from 14 December 2005 onwards because it is on this date that the first predominantly electricity business, AusNet – or SP AusNet, as it then was – listed on the ASX. When trading we allocate APA, DUET, Envestra, GasNet and Hastings to the predominantly gas portfolio and AusNet and

Spark to the predominantly electricity portfolio. We then determine what proportion of the value of each portfolio the gas and electricity operations of each of the companies in the portfolio represent.

The predominantly gas portfolio will consist largely of shares in gas businesses but it will not be a pure play gas portfolio. Similarly, the predominantly electricity portfolio will consist largely of shares in electricity businesses but it will not be a pure play electricity portfolio. We can, however, form a pure play gas portfolio from the predominantly gas portfolio and the predominantly electricity portfolio.

Let:

w_{gt}	=	the proportion of the value of the portfolio of predominantly gas firms that the gas operations of the firms in the portfolio represent;
w_{et}	=	the proportion of the value of the portfolio of predominantly electricity firms that the electricity operations of the firms in the portfolio represent; and
x_{gt}	=	the weight that a pure play gas portfolio will place on the portfolio of predominantly gas firms.

It follows that the weight that a pure play gas portfolio will place on the portfolio of predominantly electricity firms will be $1-x_{gt}$ and that the pure play weights x_{gt} and $1-x_{gt}$ can be found by solving:

$$\begin{pmatrix} w_{gt} & (1-w_{et}) \\ (1-w_{gt}) & w_{et} \end{pmatrix} \begin{pmatrix} x_{gt} \\ 1-x_{gt} \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad (4)$$

With these pure play weights we can then discover what weight the pure play gas portfolio places on each security.

A numerical example will assist in understanding how this method of forming pure play portfolios works. On Friday 29 June 2007, the predominantly gas portfolio places equal weights on APA, DUET, Envestra and Hastings while the predominantly electricity portfolio places equal weights on AusNet and Spark Infrastructure. With this information we can use the sector weights that appear in Table 2 to determine the proportion of the value of the portfolio of predominantly gas firms that the gas operations of the firms in the portfolio represent and the proportion of the value of the portfolio of predominantly electricity firms that the electricity operations of the firms in the portfolio represent. Table 5 below shows how we calculate these proportions. We find that:

$$w_{gt} = 0.850 \quad \text{and} \quad w_{et} = 0.905 \quad (5)$$

Thus the predominantly gas and electricity portfolios while close to being pure play portfolios are nevertheless not pure play portfolios. Substituting these values into (4) and solving for the pure play weights x_{gt} and $1-x_{gt}$ yields:

$$x_{gt} = 1.199 \qquad \text{and} \qquad 1-x_{gt} = -0.199 \quad (6)$$

Table 5: Determining the proportion of the value of the portfolio of predominantly gas (electricity) firms that the gas (electricity) operations of the firms in the portfolio represent

Firm	Weight	Proportion of value of firm due to operations that are		Weight × gas proportion	Weight × electricity proportion
		Gas	Electricity		
Panel A: Predominantly gas portfolio					
APA	0.250	0.910	0.090	0.228	0.023
DUET	0.250	0.580	0.420	0.145	0.105
Envestra	0.250	1.000	0.000	0.250	0.000
Hastings	0.250	0.910	0.090	0.228	0.023
				0.850	0.150
Panel B: Predominantly electricity portfolio					
AusNet	0.500	0.180	0.820	0.090	0.410
Spark	0.500	0.010	0.990	0.005	0.495
				0.095	0.905

With these values for the pure play weights in the predominantly gas and electricity portfolios, we can then determine the weights of the pure play gas portfolio in the six underlying securities. These calculations appear in Table 6.

Armed with the weights of the six securities in the pure play gas portfolio each week we are then able to compute the returns to the pure play gas portfolio each week from 23 December 2005 onwards. [15] We compute the returns to the pure play gas portfolio prior to 23 December 2005 as the return to an equally weighted portfolio of Alinta (until the end of 2002), Envestra and GasNet – all firms that operated only gas businesses.

Estimates of the equity beta of the pure play gas portfolio are provided by Table 7 for the three periods that the AER considers. The estimates differ markedly across the three periods. The period 1 and period 2 estimates in Table 7 fall below their counterparts in Table 4 while the period 3 estimate lies above its counterpart in Table 4. There is evidence from period 1 – which runs from 5 September 1997 to 17 August 2018 – that the equity beta of a pure play gas portfolio sits below 0.7. [16] One cannot reject the hypothesis that the equity beta of a pure play gas portfolio does not sit below 0.7, however, using data from period 2, which excludes the tech boom and the global financial crisis, or using data from period 3, the most recent five years.

[15] The first end-of-week to end-of-week return that we can compute for AusNet is from 16 December 2005 to 23 December 2005.

[16] Period 1 here runs from 5 September 1997 to 17 August 2018 because we do not use data on AGL and because Envestra first listed on 29 August 1997 and so the first end-of-week to end-of-week return that we can compute for Envestra is from 29 August 1997 to 5 September 1997.

Table 6: Determining the proportion of the value of the pure play gas portfolio that the gas and electricity operations of the firms in the portfolio represent

Firm	Weight	Proportion of value of firm due to operations that are		Weight × gas proportion	Weight × electricity proportion
		Gas	Electricity		
APA	0.300	0.910	0.090	0.273	0.027
AusNet	-0.099	0.180	0.820	-0.018	-0.081
DUET	0.300	0.580	0.420	0.174	0.126
Envestra	0.300	1.000	0.000	0.300	0.000
Hastings	0.300	0.910	0.090	0.273	0.027
Spark	-0.099	0.010	0.990	-0.001	-0.098
				1.000	0.000

Table 7: HoustonKemp pure-play gas portfolio equity beta estimates

	Period		
	1	2	3
Estimate	0.588	0.640	0.878
Standard error	(0.049)	(0.051)	(0.119)
P-value	[0.012]	[0.122]	[0.933]

Notes: All beta estimates are re-levered to a gearing of 60 per cent. Heteroscedasticity and autocorrelation consistent standard errors are in parentheses below estimates while p-values for tests of the null hypothesis that beta is no less than 0.7 appear in brackets.

Since the estimates differ so markedly across the three periods, we also test:

- whether the estimate of the equity beta of a pure play gas portfolio produced using data from period 3, the last five years, 23 August 2013 to 17 August 2018, differs significantly from an estimate produced using data from period 1 without period 3, 5 September 1997 to 16 August 2013; and
- whether the estimate of the equity beta of a pure play gas portfolio produced using data from period 3, the last five years, differs significantly from an estimate produced using data from period 2 without period 3, 4 January 2002 to 29 August 2008 and 6 November 2009 to 16 August 2013.

Table 8 provides the results of these exercises. The table provides:

- an estimate of the difference between the equity beta of a pure play gas portfolio over period 3 and the equity beta of a pure play gas portfolio over period 1 without period 3; and
- an estimate of the difference between the equity beta of a pure play gas portfolio over period 3 and the equity beta of a pure play gas portfolio over period 2 without period 3.

Both estimates exceed 0.325 and differ significantly from zero at conventional levels. This indicates that the equity beta of a pure play gas portfolio is higher today than it has been in the past. Beta is a relative measure

of risk. So this result may not be entirely due to changes in the characteristics of a pure play gas portfolio. The result may reflect, at least in part, a change in the characteristics of the market portfolio.

Regardless, overall our results indicate that there is no evidence from recent data that the equity beta of a pure play gas portfolio sits below 0.7 and what evidence there exists from earlier data relies on the use of data from the tech boom and the global financial crisis.

Table 8: HoustonKemp pure-play gas portfolio equity beta change estimates

	Change in equity beta to period 3 from period	
	1 without 3	2 without 3
Estimate	0.344	0.328
Standard error	(0.128)	(0.129)
P-value	[0.007]	[0.011]

Notes: All beta estimates are re-levered to a gearing of 60 per cent. Heteroscedasticity and autocorrelation consistent standard errors are in parentheses below estimates while p-values for tests of the null hypothesis that there is no change in the equity beta of a pure play gas businesses are in brackets.

A1. LAD versus OLS regression

Given a sample $\{y_t, x_t\}, t = 1,2,...,T,$ where y_t and x_t are random variables, the ordinary least squares (OLS) estimators of the parameters α and β in a linear model minimise the sum of squared errors: [17]

$$\sum_{t=1}^{T}(y_t - \alpha - \beta x_t)^2 \quad (7)$$

In contrast, the LAD estimators of the parameters α and β in a linear model minimise the sum of the absolute values of the errors:

$$\sum_{t=1}^{T}|y_t - \alpha - \beta x_t| \quad (8)$$

It can be shown that OLS will fit the model: [18]

$$\mathrm{E}(y_t \mid x_t) = \alpha + \beta x_t \quad (9)$$

where $\mathrm{E}(y_t \mid x_t)$ denotes the mean of y_t conditional on x_t, while LAD will fit the model:

$$\mathrm{Med}(y_t \mid x_t) = \alpha + \beta x_t \quad (10)$$

where $\mathrm{Med}(y_t \mid x_t)$ denotes the median of y_t conditional on x_t. Since the median is not affected by large changes in extreme observations, LAD estimates are less sensitive to outliers than are OLS estimates. As Wooldridge (2013) notes, however: [19]

> When LAD and OLS are applied to cases with asymmetric distributions, the estimated partial effect of (x_t) obtained from LAD can be very different from the partial effect obtained from OLS. But such a difference could just reflect the difference between the median and the mean and might not have anything to do with outliers.

Similarly, as Imbens and Wooldridge (2007) emphasise: [20]

> LAD is much more resilient to changes in extreme values because, as a measure of central tendency, the median is much less sensitive than the mean to changes in extreme values. But it does not follow that a large difference in OLS and LAD estimates means something is "wrong" with OLS.

Note that equation (9) implies that:

[17] This appendix is drawn from:

NERA, *Robust regression techniques: A report for DBP*, December 2014.

[18] Wooldridge, J., *Introductory econometrics: A modern approach*, South-Western CENGAGE Learning, 2013, pages 332-333.

[19] Wooldridge, J., *Introductory econometrics: A modern approach*, South-Western CENGAGE Learning, 2013, page 333.

[20] Imbens, G.W. and J. Wooldridge, *What's new in econometrics*? Lecture notes, National Bureau of Economic Research Summer Institute, 2007.

$$y_t = \alpha + \beta x_t + \varepsilon_t \quad (11)$$

where $E(\varepsilon_t) = Cov(x_t, \varepsilon_t) = 0$. From (11), it follows that:

$$\beta = Cov(x_t, y_t) / Var(x_t) \quad (12)$$

If x_t represents the return to the market portfolio and y_t the return to the equity of a firm, then equation (12) provides the formula for the equity beta of the firm. In other words, if x_t represents the return to the market portfolio and y_t the return to the equity of a firm, then the OLS parameter β that appears in equation (9) will be the equity beta of the firm.

If the conditional median $Med(y_t \mid x_t)$ differs from the conditional mean $E(y_t \mid x_t)$ by at most a constant, then the parameter β in equation (10) will match the parameter β in equation (9). If, on the other hand, the conditional median $Med(y_t \mid x_t)$ differs from the conditional mean $E(y_t \mid x_t)$ by an amount that is not constant, then the parameter β in equation (10) need not match the parameter β in equation (9).

It follows that if x_t represents the return to the market portfolio and y_t the return to the equity of a firm, then the LAD parameter β that appears in equation (10) need not be the equity beta of the firm.

A2. Missing observations

Some of the individual security returns are missing. To compute standard errors of averages across firms of OLS estimates of their equity betas that take into account the fact that some of the returns are missing requires an estimate of the covariance matrix of the estimates that takes into account this characteristic of the data. We use the following procedure.

Let N be the number of securities – here nine – and let $N - K_t$ be the number of returns missing in month t. Also let J_t be an N-dimensional identity matrix whose jth column is eliminated if the jth security's return is missing at time t. J_t will be an $N \times K_t$ matrix.

The model that we estimate can be written:

$$Y_t^* = X_t B^* + \varepsilon_t^*, \tag{13}$$

where:

Y_t^* = $\left(r_{1t}^*, r_{2t}^*, \ldots, r_{Nt}^*\right)'$

X_t = $I_N \otimes \left(1 \quad r_{mt}\right)$

I_N = an N-dimensional identity matrix

B^* = $\left(\alpha_1^*, \beta_1^*, \alpha_2^*, \beta_2^*, \ldots, \alpha_N^*, \beta_N^*\right)'$

ε_t^* = $\left(\varepsilon_{1t}^*, \varepsilon_{2t}^*, \ldots, \varepsilon_{Nt}^*\right)'$

The vector of OLS estimates can be written:

$$\hat{B}^* = \left(\sum_{t=1}^{T} X_t' J_t J_t' X_t\right)^{-1} \sum_{t=1}^{T} X_t' J_t J_t' Y_t^*, \tag{14}$$

where a hat denotes an OLS estimate.

If $\mathrm{E}\left(\varepsilon_t^* \left(\varepsilon_{t-w}^*\right)'\right) = 0$ for $|w| > 0$, then under the usual regularity conditions a heteroscedasticity consistent estimate of the covariance matrix of the OLS estimate $\hat{B}^*$ will be:

$$\left(\sum_{t=1}^{T} X_t' J_t J_t' X_t\right)^{-1} \sum_{t=1}^{T} X_t' J_t \hat{\varepsilon}_t \hat{\varepsilon}_t' J' X_t \left(\sum_{t=1}^{T} X_t' J_t J_t' X_t\right)^{-1} \tag{15}$$

A3. Terms of reference

Expert terms of reference

APGA gas equity beta brief

2018-23 AER rate of return guidelines — September 2018

The Australian Energy Regulator (AER) released its draft rate of return guideline on 10 July 2018. In the draft guideline, the AER cuts the equity betas of both the electricity and gas firms that it regulates from 0.7 to 0.6. [21] Thus the regulator does not accept the contention of the Australian Pipelines and Gas Association (APGA) that the equity beta of a gas business should not fall below 0.7. [22]

The APGA would like the expert to focus on the companies shown below (table taken from page 262 of the AER *Draft Guidelines Explanatory Statement*) to estimate a gas only equity beta. To carry out this task, the expert will need to assess what proportion of the value of each firm its gas operations represent.

Table 36 Firms in the AER's comparator set

Firm (ASX ticker)	Time / trading period	Sectors
AGL Energy Limited (AGK)	January 1990 – October 2006	Electricity, Gas
Alinta (AAN)	October 2000 – August 2007	Gas
APA Group (APA)	June 2000 – present	Gas, Minority interest in other energy infrastructure
DUET Group (DUE)	August 2004 – April/May 2017	Electricity, Gas
Envestra Ltd. (ENV)	August 1997 – October 2014	Gas
GasNet (GAS)	December 2001 – November 2006	Gas
Hastings Diversified Utilities Fund (HDF)	December 2004– November 2012	Gas
Spark Infrastructure Group (SKI)	March 2007[935] – present	Electricity, Gas
AusNet Services (AST), formerly SP AusNet (SPN)	December 2005 – present	Electricity, Gas

Source: AER analysis

In estimating a gas only equity beta, the expert should use the periods that the AER employs, that is: [23]

- the longest period available;
- the longest period available, excluding the 'technology bubble' and the global financial crisis; and
- the last five years of available data.

The consultant should also use the same method of re-levering estimates that the AER employs to ensure congruence.

[21] AER, *Draft rate of return guidelines: Explanatory statement*, July 2018, page 17.

[22] APGA, *Submission to the AER: Review of rate of return guideline*, 4 May 2018, page 4.

[23] AER, Staff beta analysis, June 2017.

The APGA would like the expert to use the nine Australian regulated energy utilities that form the AER's comparator set and the three periods that the AER examines to:

- provide an estimate of the equity beta of an Australian gas business in each period; and
- test whether each estimate falls significantly below 0.7.

A4. Curriculum vitae

Simon M. Wheatley

Tel: [redacted]
E-mail: [redacted]

Overview

Simon is a special adviser to HoustonKemp and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his expertise outside the university sector to solving problems in consulting and in fund management. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington. Simon's interests and expertise are in how assets are priced.

Employment

- Special Adviser, HoustonKemp, 2015-
- Affiliated Industry Expert, NERA Economic Consulting, 2014-2015
- Special Consultant, NERA Economic Consulting, 2009-2014
- External Consultant, NERA Economic Consulting, 2008-2009
- Quantitative Analyst, Victorian Funds Management Corporation, 2008-2009
- Adjunct, Melbourne Business School, 2008
- Professor, Department of Finance, University of Melbourne, 2001-2008
- Associate Professor, Department of Finance, University of Melbourne, 1999-2001
- Associate Professor, Australian Graduate School of Management, 1994-1999
- Visiting Assistant Professor, Graduate School of Business, University of Chicago, 1993-1994
- Visiting Assistant Professor, Faculty of Commerce, University of British Columbia, 1986
- Assistant Professor, Graduate School of Business, University of Washington, 1984-1993

Education

- Ph.D., University of Rochester, USA, 1986; Major area: Finance; Minor area: Applied statistics; Thesis topic: Some tests of international equity market integration; Dissertation committee: Charles I. Plosser (chairman), Peter Garber, Clifford W. Smith, Rene M. Stulz
- M.A., Economics, Simon Fraser University, Canada, 1979
- M.A., Economics, Aberdeen University, Scotland, 1977

Publicly Available Reports

HoustonKemp

- A Constructive Review of the ERA's Approach to the MRP: A report for Western Power, June 2017 (with Brendan Quach)
- The Cost of Equity and the Low-Beta Bias: A report for Multinet, November 2016
- Evaluating Forecasts: Response to the ERA's Draft Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline 2016 – 2020: A report for DBP, February 2016
- The Black CAPM: Response to the ERA's Draft Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline 2016 – 2020: A report for DBP, February 2016
- The Cost of Equity: Response to the AER's Draft Decisions for the Victorian Electricity Distributors, ActewAGL Distribution and Australian Gas Networks: A report for ActewAGL Distribution, AusNet Services, Australian Gas Networks, CitiPower, Jemena Electricity Networks, Powercor and United Energy, January 2016
- Equity Beta for a Benchmark Australian Water Network Service Provider: A report for Sydney Water, June 2015 (with Greg Houston, Brendan Quach and Dale Yeats)

NERA

- Estimating Distribution and Redemption Rates: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors, and for Jemena Gas Networks: A report for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy, June 2015
- Further Assessment of the Historical MRP: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors: A report for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Energex, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy, June 2015
- The Cost of Equity: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors, and for Jemena Gas Networks: A report for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy, June 2015
- The Cost of Equity: A Critical Review of the Analysis of the AER and its Advisors: A report for DBP, June 2015
- Do Imputation Credits Lower the Cost of Equity? Cross-Sectional Tests: A report for United Energy, April 2015
- The Relation Between the Market Risk Premium and Risk-Free Rate: Evidence from Independent Expert Reports: A report for United Energy, April 2015
- Review of the Literature in Support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French Three-Factor Model A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA PowerNetworks, and United Energy, March 2015
- Estimating Distribution and Redemption Rates from Taxation Statistics A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA PowerNetworks and United Energy, March 2015
- Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy, February 2015

- Historical estimates of the market risk premium: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausgrid, AusNet Services, Australian Gas Networks, CitiPower, Endeavour Energy, Energex, Ergon, Essential Energy, Powercor, SA Power Networks and United Energy, February 2015
- Robust regression techniques: A report for DBP, December 2014
- Imputation Credits and Equity Returns: A report for the Energy Networks Association, October 2013 (with Brendan Quach)
- The Fama-French Three-Factor Model: A report for the Energy Networks Association, October 2013 (with Brendan Quach)
- The Market Risk Premium: Analysis in Response to the AER's Draft Rate of Return Guidelines: A report for the Energy Networks Association, October 2013 (with Brendan Quach)
- The Market, Size and Value Premiums: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- Estimates of the Zero-Beta Premium: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- The Payout Ratio: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- Review of Cost of Equity Models: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- The Cost of Equity for a Regulated Energy Utility: A Response to the QCA Discussion Paper on the Risk-Free Rate and the MRP: A report for United Energy and Multinet Gas, March 2013 (with Brendan Quach)
- The Cost of Equity for a Regulated Energy Utility: A report for Multinet, February 2013 (with Brendan Quach)
- The Black CAPM: A report for APA Group, Envestra, Multinet & SP AusNet, March 2012 (with Brendan Quach)
- Prevailing Conditions and the Market Risk Premium: A report for APA Group, Envestra, Multinet & SP AusNet, March 2012 (with Brendan Quach)
- The Market Risk Premium: A report for CitiPower, Jemena, Powercor, SP AusNet and United Energy, 20 February 2012 (with Brendan Quach)
- Cost of Equity in the ERA DBNGP Draft Decision: A report for DBNGP, 17 May 2011 (with Brendan Quach)
- The Market Risk Premium: A report for Multinet Gas and SP AusNet, 29 April 2011 (with Brendan Quach)
- Cost of Capital for Water Infrastructure Company Report for the Queensland Competition Authority, 28 March 2011 (with Brendan Quach)
- The Cost of Equity: A report for Orion, 2 September 2010 (with Greg Houston and Brendan Quach)
- New Gamma Issues Raised by AER Expert Consultants: A report for JGN, 17 May 2010 (with Brendan Quach)
- The Required Rate of Return on Equity for a Gas Transmission Pipeline: A Report for DBP, 31 March 2010 (with Brendan Quach)
- Jemena Access Arrangement Proposal for the NSW Gas Networks: AER Draft Decision: A report for Jemena, 19 March 2010 (with Greg Houston and Brendan Quach)
- Payout Ratio of Regulated Firms: A report for Gilbert + Tobin, 5 January 2010 (with Brendan Quach)

- Review of Da, Guo and Jagannathan Empirical Evidence on the CAPM: A report for Jemena Gas Networks, 21 December 2009 (with Greg Houston and Brendan Quach)
- The Value of Imputation Credits for a Regulated Gas Distribution Business: A report for WA Gas Networks, 18 August 2009 (with Greg Houston, Brendan Quach and Tara D'Souza)
- Cost of Equity - Fama-French Three-Factor Model Jemena Gas Networks (NSW), 12 August 2009 (with Jeff Balchin, Greg Houston and Brendan Quach)
- Estimates of the Cost of Equity: A report for WAGN, 22 April 2009 (with Brendan Quach)
- AER's Proposed WACC Statement – Gamma: A report for the Joint Industry Associations, 30 January 2009 (with Greg Houston and Brendan Quach)
- The Value of Imputation Credits: A report for the ENA, Grid Australia and APIA, 11 September 2008 (with Greg Houston and Brendan Quach)

Consulting Experience

- HoustonKemp, 2015 -
- NERA, 2008 - 2015
- Lumina Foundation, Indianapolis, 2009
- Industry Funds Management, 2010

Academic Publications

- Imputation credits and equity returns, (with Paul Lajbcygier), 2012, *Economic Record* 88, 476-494.
- Do measures of investor sentiment predict returns? (with Robert Neal), 1998, *Journal of Financial and Quantitative Analysis* 33, 523-547.
- Adverse selection and bid-ask spreads: Evidence from closed-end funds (with Robert Neal), 1998, *Journal of Financial Markets* 1, 121-149.
- Shifts in the interest-rate response to money announcements: What can we say about when they occur? (with V. Vance Roley), 1996, *Journal of Business and Economic Statistics* 14, 135-138.
- International investment restrictions and closed-end country fund prices, (with Catherine Bonser-Neal, Greggory Brauer, and Robert Neal), 1990, *Journal of Finance* 45, 523-547 (reprinted in International Capital Markets Volume III, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).
- A critique of latent variable tests of asset pricing models, 1989, *Journal of Financial Economics* 21, 177-212.
- Some tests of international equity market integration, 1988, *Journal of Financial Economics* 21, 177-212 (reprinted in International Capital Markets Volume I, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).
- Some tests of the consumption-based asset pricing model, 1988, *Journal of Monetary Economics* 22, 193-215.

Working Papers

- An evaluation of some alternative models for pricing Australian stocks (with Paul Lajbcygier), 2009.
- Intertemporal substitution, small-sample bias, and the behaviour of U.S. household consumption (with Kogulakrishnan Maheswaran and Robert Porter), 2007.
- Keeping up with the Joneses, human capital, and the home-equity bias (with En Te Chen), 2003.
- Evaluating asset pricing models, 1998.
- Time-non-separable preferences or artifact of temporal aggregation? (with Robert Porter), 2002.
- Testing asset pricing models with infrequently measured factors, 1989.

Refereeing Experience

- Referee for Accounting and Finance, the Australian Journal of Management, Economic Letters, Financial Analysts Journal, Financial Management, Journal of Accounting and Economics, Journal of Business, Journal of Empirical Finance, Journal of Finance, Journal of Financial and Quantitative Analysis, Journal of Financial Economics, Journal of Futures Markets, Journal of International Economics, Journal of International Money and Finance, Journal of Money, Credit, and Banking, Journal of Monetary Economics, Management Science, National Science Foundation, Pacific-Basin Finance Journal, and the Review of Financial Studies.
- Program Committee for the Western Finance Association in 1989 and 2000.

Teaching Experience

- International Finance, Melbourne Business School, 2008
- Corporate Finance, International Finance, Investments, University of Melbourne, 1999-2008
- Corporate Finance, International Finance, Investments, Australian Graduate School of Management, 1994-1999
- Investments, University of Chicago, 1993-1994
- Investments, University of British Columbia, 1986
- International Finance, Investments, University of Washington, 1984-1993
- Investments, Macroeconomics, Statistics, University of Rochester, 1982
- Accounting, 1981, Australian Graduate School of Management, 1981

Teaching Awards

- MBA Professor of the Quarter, Summer 1991, University of Washington

Computing Skills

- User of SAS since 1980. EViews, Excel, LaTex, Matlab, R, Visual Basic. Familiar with the SIRCA SPPR, Compustat and CRSP databases. Some familiarity with Bloomberg, FactSet and IRESS.

Board Membership

- Anglican Funds Committee, Melbourne, 2008-2011

Honours

- Elected a member of Beta Gamma Sigma, June 1986.

Fellowships

- Earhart Foundation Award, 1982-1983
- University of Rochester Fellowship, 1979-1984
- Simon Fraser University Fellowship, 1979
- Inner London Education Authority Award, 1973-1977

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APPENDIX B:

Frontier Economics, *Low-beta bias and the Black CAPM*, September 2018

Low-beta bias and the Black CAPM

REPORT PREPARED FOR AUSTRALIAN GAS INFRASTRUCTURE GROUP AND APA GROUP

September 2018

Low-beta bias and the Black CAPM

Contents

Contents

Low-beta bias and the Black CAPM

Figures

Tables

1 Executive summary

1.1 Instructions

1 Frontier Economics has been engaged by Australian Gas Infrastructure Group (AGIG) and APA Group to provide expert advice in relation to the issue of the role of low-beta bias and the Black CAPM when estimating the equity beta as part of the implementation of the Sharpe-Lintner CAPM (SL-CAPM) in the context of the Foundation Model approach to setting the allowed return on equity.

2 Specifically, we have been asked to:

a. Consider the context of the ERA's approach to the evidence of low-beta bias and the Black CAPM – informed by recent decisions and merits review processes.

b. Review the empirical evidence which shows that the relationship between beta and observed returns has a higher intercept and a flatter slope than the SL-CAPM suggests.

c. Review approaches that have been proposed to test whether the same relationship between beta and *ex post* observed returns also holds in relation to *ex ante* expected returns, and examine the relationship between beta and expected returns in the Australian data.

d. Review the concept of an 'expected equilibrium return' and comment upon (a) whether the SL-CAPM is the only viable equilibrium model and (b) whether the observed data is relevant to informing the implementation of an expected equilibrium model.

1.2 Background and context

Empirical and theoretical evidence of bias in SL-CAPM return estimates

3 Over several decades, the empirical finance literature has consistently reported that the relationship between beta and observed returns has a higher intercept and a flatter slope than the SL-CAPM suggests. Thus, the SL-CAPM systematically under-states the returns on stocks with beta estimates less than one. That is, low-beta stocks systematically earn higher returns than the SL-CAPM would predict – the model does not fit the observable data. This empirical evidence is known by Australian regulators as 'low-beta bias.'

4 Black (1972) has developed a theoretical model that produces output that is more consistent with the empirical evidence. The 'Black CAPM' replaces one of the strong assumptions of the SL-CAPM and it produces a relationship between beta and returns that has a higher intercept and a flatter slope – consistent with the

evidence. Subsequent models have modified other SL-CAPM assumptions in deriving equilibrium models that also fit the observed data better than the SL-CAPM.

5 Thus, there are two sides of the coin in relation to this evidence:

a. There is an *empirical* aspect of this body of evidence – the relationship between beta and observed returns has a higher intercept and a flatter slope than the SL-CAPM suggests; and

b. There is a *theoretical* aspect of this body of evidence – the Black CAPM and subsequent models demonstrate that a change to SL-CAPM assumptions produces a higher intercept and a flatter slope, consistent with the empirical evidence.

The ERA's consideration of low-beta bias

6 In its 2013 Guideline, and in a number of subsequent decisions, the ERA accepted the empirical evidence of low-beta bias and gave effect to that evidence by using it to inform the selection of its equity beta point estimate:

> The Authority recognises that typical empirical applications of the Sharpe Lintner CAPM may under-estimate equity beta for low beta stocks, with the potential to lead to a downwards bias in the estimate of the return on equity. As a practical response, the Authority will take this into account when determining the point estimate of the equity beta for use in the Sharpe Lintner CAPM.[1]

7 The ERA maintained this approach in its December 2015 DBP Draft Decision, but changed approach in its June 2016 DBP Final Decision. In that decision, the ERA determined that the evidence of low-beta bias or the Black CAPM would no longer be given any effect when selecting the beta point estimate.

8 In its DBP Final Decision, the ERA determined that:

a. The evidence of low-beta bias does not imply that beta estimates are biased, but rather that the SL-CAPM produces downwardly biased estimates of the required return for low-beta stocks. Consequently, the evidence should not be accounted for via an adjustment to its beta estimate, but via an adjustment to the model – by using a higher intercept (or 'alpha'); and

b. The evidence was insufficient to warrant any such adjustment being made at the time. This was because the evidence in question was drawn from observed (*ex post)* returns whereas the SL-CAPM relates to (*ex ante*) expected returns.

9 In the DBP limited merits review proceedings, the Tribunal held that the approach adopted in the DBP Final Decision was open to the ERA.

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[1] ERA, December 2013, Rate of Return Guideline, Explanatory Statement, Appendices, Paragraph 27.

10 In its recent Draft Rate of Return Guideline, the ERA has maintained the approach of giving no weight to the empirical evidence of low-beta bias or the theoretical evidence of the Black CAPM.

11 In this report, we take the ERA's current position as the starting point:

a. That any problem to be remedied relates to the model itself and not to the empirical estimates of beta; and

b. That there is insufficient evidence of a low beta-bias in *expected* returns, because the evidence focuses on *observed* returns and it may be the case that actual returns have systematically differed from what investors required or expected.

1.3 Primary conclusions

12 Our primary conclusions are set out below.

The evidence of low-beta bias in expected returns

13 In Section 3 below, we demonstrate that the literature contains a number of approaches for estimating expected returns directly, rather than using observed returns as a proxy. These expected returns are estimated using information from current stock prices, dividend forecasts, and analyst target prices.

14 The literature demonstrates that the *ex ante* required returns produce the same result that has been documented for *ex post* observed returns – the relationship between beta and required returns has a higher intercept and a flatter slope than the SL-CAPM would suggest.

We have applied this methodology to Australian data and we also find the same result – the relationship between beta and *expected* returns has a higher intercept and a flatter slope than the SL-CAPM would suggest. We have followed Brav et al (2005) in analysing and reporting *excess* returns – in excess of the prevailing risk-free rate. In the parlance of the ERA the SL-CAPM posits an 'alpha' of zero. By contrast, Table 1 below reports a statistically significant positive intercept in expected returns – the same relationship that has been identified in observed returns.

Table 1: Results for Australian sample compared with the results of Brav et al. (2005) and with values adopted by the ERA

	ERA	Brav – Value Line	Brav – First Call	Individual Firm Level	Portfolio Level Decile	Portfolio Level Quintile
		US data		Australian data		
Intercept (Alpha)	0	0.07	0.20	0.07	0.07	0.07
(*t*-statistic)		(3.2)	(5.8)	(12.66)	(12.09)	(12.11)
Slope	0.062	0.07	0.07	0.01	0.01	0.01
(*t*-statistic)		(5.1)	(4.3)	(2.08)	(1.81)	(2.5)

Source: AER, Brav et al (2005), Datastream, Frontier Economics calculations. ERA allowances taken from Western Power Final Decision.

What can be made of the empirical evidence from observed returns?

15 Even if the market *is* in equilibrium (i.e., investors have priced stocks such that they expect to receive a return equal to that which they require) it is still theoretically possible that *observed* returns over a period might turn out to be different from what was required/expected.

16 If one of the available equilibrium models is selected (the ERA has selected the SL-CAPM) and we observe that actual returns are systematically inconsistent with that model in some respect (e.g., higher intercept and flatter slope), there are two potential explanations:

a. The selected model does not perfectly describe the process by which the aggregate market determines required returns; or

b. The selected model *does* perfectly describe the process by which the aggregate market determines required returns, but the actual returns over the period that was examined happened to deviate from the return that investors required/expected due to random chance.

17 The ERA has, to date, concluded in favour of the second explanation. The ERA's current approach is to implement the SL-CAPM (among the set of equilibrium asset pricing models) without regard to the empirical evidence that is systematically inconsistent with that model.

18 When assessing the reasonableness of the ERA's approach of placing 100% faith in the SL-CAPM and applying 0% weight to the empirical evidence, the relevant considerations include:

a. The empirical evidence of low-beta bias is the most consistent, compelling and well-accepted empirical evidence in the field of

asset pricing. The contributors to this literature include two Nobel Prize winners and the studies documenting low-beta bias have been published in the very top finance journals over several decades, and the empirical evidence of low-beta bias is so well-accepted that it appears in the standard finance textbooks; and

b. The literature since the documentation of low-beta bias has not questioned whether or not the empirical evidence is a real reflection of the returns that investors require/expect. Rather, the literature has focused on identifying and modifying the components of the SL-CAPM that lead to it systematically understating the returns on low-beta stocks.

The evidence is relevant and robust and should not be disregarded

19 We have been asked to provide a view on the binary qualitative question of whether the empirical evidence of low-beta bias should have a real role in the process for estimating the required return on equity. In our view, there are compelling reasons to have real regard to that evidence if the goal is to produce the best possible estimate of the required return on equity.

1.4 Author of report

20 This report has been authored by Professor Stephen Gray, Professor of Finance at the UQ Business School, University of Queensland and Director of Frontier Economics, a specialist economics and corporate finance consultancy. I have Honours degrees in Commerce and Law from the University of Queensland and a PhD in Financial Economics from Stanford University. I teach graduate level courses with a focus on cost of capital issues, I have published widely in high-level academic journals, and I have more than 20 years' experience advising regulators, government agencies and regulated businesses on cost of capital issues. I have published a number of papers that specifically address beta estimation issues. A copy of my curriculum vitae is attached as an appendix to this report.

21 My opinions set out in this report are based on the specialist knowledge acquired from my training and experience set out above. I have been provided with a copy of the Federal Court's Expert Evidence Practice Note GPN-EXPT, which comprises the guidelines for expert witnesses in the Federal Court of Australia. I have read, understood and complied with the Practice Note and the Harmonised Expert Witness Code of Conduct that is attached to it.

2 Background and context

2.1 The evidence of low-beta bias

22 Soon after the publication of the Sharpe-Lintner CAPM, researchers began testing whether the predictions (or, more precisely, the empirical implications) of the model were supported in real-world data. The conclusion from this evidence is that the empirical implementation of the SL-CAPM provides a poor fit to the observed data. In particular, the actual returns on low-beta stocks systematically and materially exceed the SL-CAPM estimates; a result that is known as low-beta bias. The feasible implementation of the SL-CAPM does not fit the observed data.

23 The literature documenting low-beta bias has been performed by the very top echelon of finance researchers, including two Nobel prize winners. Low beta bias has been consistently documented across a number of markets and is documented in the standard finance textbooks.

24 There is currently no real debate about this empirical evidence from observed stock returns. The relationship between beta and returns has a higher intercept and a flatter slope than the SL-CAPM suggests. For example, the AER's recent Draft Guideline Explanatory Statement states that:

> We acknowledge that ex-post return data can indicate that actual returns exceed expected returns for low beta stocks. [2]

25 Also, most of the experts in the AER's concurrent evidence sessions agreed with the proposition that:

> There is sound evidence that low-beta stocks have exhibited higher returns than the S-L CAPM predicts.[3]

26 The relevant evidence is depicted in Figure 1 below and some it is summarised in Appendix 1 to this report.

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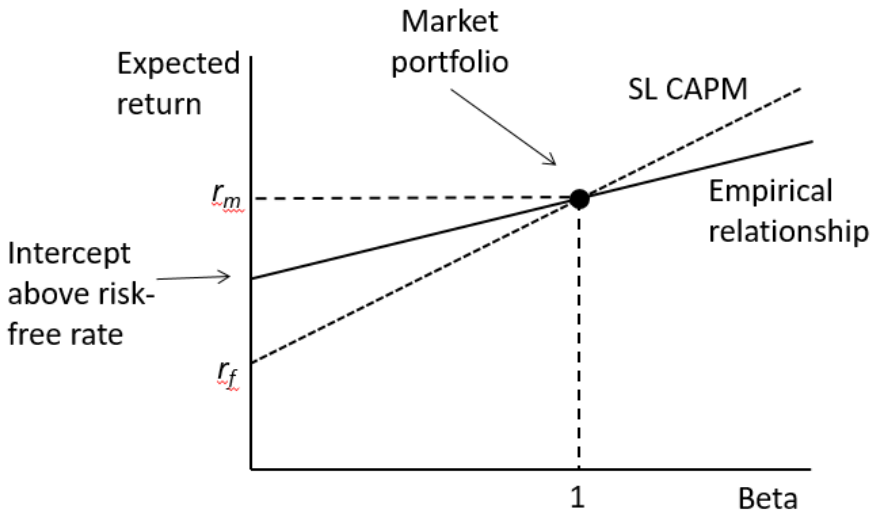
[2] AER, July 2018, Draft Rate of Return Guideline, Explanatory Statement, p. 277.

[3] Joint Experts' Report, Proposition 5.21, p. 52. No experts disputed the existence of the empirical evidence, but instead stated that the size of the bias is difficult to reliably quantify.

Figure 1: Sharpe-Lintner CAPM vs. observed empirical relationship.



2.2 The ERA's treatment of low-beta bias in the 2013 Guideline

27 In its 2013 Rate of Return Guideline, the ERA concluded that it should have regard to the empirical evidence of low-beta bias and the theoretical evidence of the Black CAPM. The ERA considered that there was no sufficiently reliable estimate of the quantum of the bias, in which case it would give effect to that evidence when selecting the beta point estimate to be used in the SL-CAPM:

> The Authority recognises that typical empirical applications of the Sharpe Lintner CAPM may under-estimate equity beta for low beta stocks, with the potential to lead to a downwards bias in the estimate of the return on equity. As a practical response, the Authority will take this into account when determining the point estimate of the equity beta for use in the Sharpe Lintner CAPM.[4]

and:

> the Authority intends to account for empirical evidence relating to potential bias in the estimates of the equity beta, that are used in applying the Sharpe Lintner CAPM. The Authority considers that such an approach would account for much of the evidence supporting the use of the Empirical and Black CAPM models.[5]

2.3 The ERA's 2015 Draft Decision for DBP

28 In its 2015 submission to the ERA, DBP proposed an empirical technique for quantifying the extent of the bias and submitted that the informal adjustment the ERA had made to its beta estimate in the 2013 Guideline was inadequate.

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[4] ERA, December 2013, Rate of Return Guideline, Explanatory Statement, Appendices, Paragraph 27.

[5] ERA, December 2013, Rate of Return Guideline, Explanatory Statement, Appendices, Paragraph 50.

However, in its December 2015 Draft Decision, the ERA concluded that DBP's proposed adjustment was too high.[6]

29 The ERA concluded that it would continue to give effect to this evidence when selecting the beta point estimate:

> None of the estimates of a return on equity that are made using the Black CAPM are sufficiently robust. The Authority considers that it is therefore impractical to utilise the Black CAPM to determine the return on equity directly.
>
> However, the Authority will recognise the theoretical insight from the Black CAPM when estimating a return on equity with the Sharpe Lintner CAPM. The Authority will have regard to these outcomes when estimating the equity beta from within the estimated range.[7]

30 This led the ERA to select a point estimate 'towards the top' of the empirical range. Specifically, the ERA considered the appropriate empirical range to be 0.3 to 0.8, with a best statistical estimate of 0.5.[8] In having regard to the "potential for the use of the Sharpe Lintner CAPM to underestimate returns,"[9] the ERA adopted a beta of 0.7.

2.4 The ERA's 2016 Final Decision for DBP

No effect given to low-beta bias or the Black CAPM

31 The ERA updated its empirical beta estimates for its June 2016 Final Decision for DBP. The updated analysis indicated a material increase in beta estimates. The ERA concluded that the best statistical estimate had increased from 0.5 (in the Draft Decision) to 0.7. However, the ERA determined that the evidence of low-beta bias or the Black CAPM would no longer be given any effect when selecting the beta point estimate, in which case the allowed beta remained at 0.7.[10]

Interpretation of 'low beta bias'

32 The DBP Final Decision draws a distinction between two possible interpretations of the term 'low beta bias' that is used to describe the empirical evidence that low-beta stocks systematically generate higher returns than the SL-CAPM would suggest:

a. **Interpretation 1: The problem lies in the empirical estimation of beta**

   One possible explanation is that the betas are under-estimated. That is, the true beta is above the empirical estimate. In this case,

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[6] ERA, December 2015, DBP Draft Decision, Paragraph 188.

[7] ERA, December 2015, DBP Draft Decision, Paragraph 746-747.

[8] ERA, December 2015, DBP Draft Decision, Paragraph 249, 255.

[9] ERA, December 2015, DBP Draft Decision, Paragraph 256.

[10] ERA, December 2015, DBP Final Decision, Paragraph 474.

if the return is consistent with the true (higher) beta, there will appear to be out-performance relative to the (lower) empirical estimate of beta.

b. **Interpretation 2: The problem lies in the SL-CAPM being inconsistent with real-world required returns**

The alternative explanation is that the SL-CAPM (which is a very simple theoretical economic model) may not fully capture the returns that investors require. Thus, even if betas can be perfectly estimated, the model (that converts beta into expected returns) may be inadequate.

33 When DBP has raised the issue of low-beta bias it has been in the context of the second explanation – the SL-CAPM produces downwardly biased estimates of the required return on low-beta stocks. That is, the problem, is not with the estimates of beta, but with the model in which those estimates are used. This is obvious in Figure 1 above.

34 Although the problem is with the model itself, the ERA has previously given effect to this evidence via an adjustment to the equity beta. By way of analogy, consider a watch that runs slow and loses two minutes over the course of a week. One remedy would be to fix the mechanism so that it keeps time more accurately. An alternative is to wind the minute hand forward a little at the end of each week. The second remedy of moving the minute hand forward would be adequate, even though there is no problem with the minute hand itself (it is not bent or loose).

35 In its DBP Final Decision, the ERA notes that there is no problem with the minute hand (beta estimate) and that the problem is with the mechanism itself (the SL-CAPM). However, the Final Decision concludes that, because there is no problem with the beta estimate it should make no adjustment to the beta estimate. Thus, the ERA concludes that, if any effect is to be given to this evidence, it would have to be by an adjustment to the model. As shown in Figure 1 above, this would involve using a higher intercept, which the ERA refers to as 'alpha.' However, the ERA concludes that the evidence 'at the current time' does not support such an adjustment to the model:

> The Authority has concluded that, if any adjustment could be justified, it should apply to the intercept term in the SL-CAPM, thereby taking account of the alpha term arising in ex post tests of the model. However, the Authority is not convinced there is adequate evidence, at the current time, to justify making such an adjustment.[11]

Ex ante vs ex post returns

36 To support its conclusion that the evidence at the current time does not support any adjustment to the SL-CAPM, the ERA identifies the difference between ex ante required returns and ex post observed returns.[12] The ERA noted that it is

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[11] ERA, December 2015, DBP Final Decision, Paragraph 436.

[12] This point can be explained via a simple example. Suppose investors expect a particular asset to produce a payoff of $110 one year from now, and they consider that a 10% return would be appropriate. In this

seeking an estimate of *ex ante* required returns, whereas the evidence of low-beta bias is based on *ex post* observed returns:

> It follows that this conceptual difference between expectations and outcomes is a major problem for ex post tests of asset pricing models, such as that proposed by DBP. Rational investors do not take on the additional risk of equity expecting it to deliver less than less risky debt, yet this has been an actual outcome in the market over recent times. DBP is not actually testing the return on equity models against investors' *expectations* for the return, ex ante, as it needs to do in order to determine whether the outputs of the asset pricing models are biased. Rather, it is testing those models against *actual outcomes, realised ex post*. DBP has not recognised this distinction, which constitutes an error.[13]

37 DBP has submitted that actual (*ex post*) stock returns might differ from investors' (*ex ante*) required return over a short period. But over time, investors will continue to price assets on the basis of their required return. In some cases, the actual return will turn out to be higher than they expected/required and in some cases it will be lower – for a host of different reasons. But over a period of time, the average observed return will reflect the expected/required return that investors used when pricing the asset. That is, if investors price assets to generate an expected return of 10%, we would expect to observe a realised return of 10% on average over time. Thus, the average observed return over a period of time reflects the return that investors expect/require. Indeed, this is the whole basis for using observed market data for *any* parameter estimation purpose.

2.5 The Australian Competition Tribunal

38 When considering the ERA's departure from its Guideline approach to estimating beta, the Tribunal drew attention to the ex ante/ex post distinction in the ERA's reasoning, citing a number of passages from the Final Decision, including:

> At the same time, the Authority is not convinced there is any empirical evidence at the current time to justify an adjustment to the SL-CAPM for expected alpha for the benchmark efficient entity.[14]

and:

> The Authority now considers, given these insights, that there is inadequate evidence, at this time, to justify departure from an ex-ante alpha estimate of zero in its implementation of the SL-CAPM.[15]

39 The Tribunal concluded that:

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case, investors would price that asset at $100, expecting to receive their (ex ante) required return of 10%. Suppose that at the end of the year the actual payoff from the investment is $105. In this case, the (ex post) observed return is 5%. Thus, there is a difference between the ex post observed return and the ex ante required return.

[13] ERA, December 2015, DBP Final Decision, Paragraph 267.

[14] Application by DBNGP (WA) Transmission Pty Ltd [2018] ACompT 1, 16 July, p. 94.

[15] Application by DBNGP (WA) Transmission Pty Ltd [2018] ACompT 1, 16 July, p. 94.

> …the ERA noted (correctly) that this conceptual difference between expectations and outcome is a major problem for *ex post* tests of asset pricing models, such as that proposed by the owners in the present case. The ERA said (correctly) that rational investors do not take on the additional risk of equity expecting it to deliver less than risky debt, yet this has been an actual outcome in the market over recent times. The ERA noted that the approach of the owners did not actually test the return on equity models against investors' expectations for that return, *ex ante*, as it would need to do in order to determine whether the outputs of the asset pricing models are biased. Rather, so the ERA said, the owners are testing those models against actual outcomes, realised in *ex post*. [16]

2.6 The role of this report

40 Our understanding of the current position in relation to low-beta bias and Black CAPM, within the ERA's regulatory process, is as follows:

a. There is broad acceptance of the empirical evidence that the relationship between observed stock returns and beta estimates has a higher intercept and flatter slope than the SL-CAPM suggests;

b. There is also broad agreement that the market will generally be in equilibrium, where investors have priced stocks such that the expected return is equal to their required return. Thus, there is an equivalence between expected and required returns;[17]

c. The ERA considers that there may be a difference between *ex post* observed returns and *ex ante* expected/required returns. Thus, it is theoretically possible that the expected/required return of investors is consistent with the SL-CAPM even though the empirical evidence from actual stock returns is not; and

d. If the ERA was convinced that there was evidence that the relationship between *expected* returns and beta estimates has a higher intercept and flatter slope than the SL-CAPM suggests (consistent with the empirical evidence from observed stock returns) the ERA would give effect to that evidence via an adjustment to the intercept (which the ERA calls 'alpha') rather than an adjustment to the beta estimate.

41 In this report, we note that the standard approach in empirical finance is based on the notion that investors are unlikely to generate systematically biased expectations, on average. For example, if a particular stock consistently generated a return in excess of the market's expectation, it seems unlikely that the market would maintain the same expectation and continue to be surprised year after year. This is the basis for using observed returns (on average over a period of time) as a proxy for expected/required returns.

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[16] Application by DBNGP (WA) Transmission Pty Ltd [2018] ACompT 1, 16 July, p. 124.

[17] This point is addressed in more detail in Section 4.6 below.

42 However, given that the ERA remains concerned about the possibility of a difference between *ex post* observed returns and *ex ante* expected/required returns, we consider approaches for estimating expected returns directly, rather than using observed returns as a proxy.

43 We show that the relationship between *expected* returns and beta estimates has a higher intercept and flatter slope than the SL-CAPM suggests (consistent with the empirical evidence from observed stock returns).

44 We also consider the conditions under which observed returns provide relevant information about required/expected returns. We demonstrate the widespread acceptance of the view that observed returns do indeed provide relevant information about required/expected returns.

3 Analysis of *expected* returns

3.1 Overview

45 We have noted above that the ERA remains concerned about the possibility of a difference between *ex post* observed returns and *ex ante* expected/required returns.

46 In this section, we briefly explain why the standard approach throughout the empirical finance literature is to use observed returns (on average over a period of time) as a proxy for expected/required returns.

47 We then demonstrate that there are techniques for estimating *expected* returns directly. We review the evidence in relation to those techniques and we implement them using the Australian data. We show that the relationship between *expected* returns and beta estimates has a higher intercept and flatter slope than the SL-CAPM suggests (consistent with the empirical evidence from observed stock returns).

3.2 Using observed returns as a proxy for expected returns

48 The most common approach for estimating (*ex ante*) expected returns in the finance literature is to use average (*ex post*) observed returns as a proxy. The logic for this approach is straightforward – it is unlikely that investors in aggregate would consistently and systematically mis-estimate expected returns. Developed stock markets are deep, liquid and competitive with many participants investing material resources in estimating expected returns. As we have noted above, if a particular stock consistently generated a return in excess of the market's expectation, it seems unlikely that the market would maintain the same expectation and continue to be surprised year after year. The more likely outcome is that the market would revise its expectation to take the market evidence into account.

49 Another way of looking at this issue is in terms of investors setting the price of an asset to reflect their required return. This point can be explained via a simple example. Suppose investors expect a particular asset to produce a payoff of $110 one year from now, and they consider that a 10% return would be appropriate. In this case, investors would price that asset at $100, expecting to receive their (ex ante) required return of 10%. Suppose that at the end of the year the actual payoff from the investment is $105. In this case, the (ex post) observed return is 5%. Thus, there is a difference between the ex post observed return and the ex ante required return.

50 Over time, investors will continue to price assets on the basis of their required return. In some cases, the actual return will turn out to be higher than they expected/required and in some cases it will be lower – for a host of different reasons. But over a period of time, the average observed return will reflect the expected/required return that investors used when pricing the asset. That is, if investors price assets to generate an expected return of 10%, we would expect to

observe a realised return of 10% on average over time. Thus, the average observed return over a period of time reflects the return that investors expect/require.

51 Indeed, this is the whole basis for using observed market data for *any* parameter estimation purpose. For example, the ERA estimates equity beta and the market risk premium using observed stock returns – on the basis that those observed returns reflect the required return of investors.

52 If observed returns cannot be relied upon to reflect investors' required/expected returns for the purposes of assessing low-beta bias, they cannot be relied upon for any other purpose. That is, it would be illogical to rely on observed stock returns to estimate beta and MRP (on the basis that returns reflect investor expectations) but to then conclude that the same returns are unreliable (on the basis that they do not, or may not, reflect investor expectations) when considering low-beta bias.

3.3 Direct estimation of expected returns

53 Section 2 above explains that the ERA does not rely on observed stock returns when assessing the evidence that the observed relationship between beta and returns has a higher intercept and a flatter slope than the SL-CAPM would suggest. The ERA relies on the potential difference between *ex ante* required returns and *ex post* observed returns to justify disregarding this evidence.

54 Whether low-beta bias is also present in *expected* returns can be examined using direct estimates of *ex ante* expected returns rather than *ex post* observed returns as a proxy. The seminal paper in this area is Brav, Lehavey and Michaely (2005)[18] who replace observed *ex post* returns with *ex ante* expected/required returns in the empirical tests that have been developed in this area over some decades. Their estimate of expected/required returns is extracted from analyst estimates, as explained below. The use of implied returns extracted from analyst reports is motivated by the fact that there is a rich literature documenting the value-relevance of analyst forecasts. Section 3.6 below documents some of the research that shows how stock prices are sensitive to analyst forecast information.

55 Brav et al (2005) report that the *ex ante* expected returns produce the same result that has been documented for *ex post* observed returns – the relationship between beta and required returns has a higher intercept and a flatter slope than the SL-CAPM would suggest.

56 We have applied the Brav et al (2005) methodology to Australian data and we also find the same result – the relationship between beta and expected returns has a higher intercept and a flatter slope than the SL-CAPM would suggest.

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[18] Brav, A., R. Lehavy, and R. Michaely, 2005. "Using expectations to test asset pricing models," *Financial Management*, Autumn, 31–64.

3.4 The Brav et al (2005) methodology

3.4.1 Approach

57 Brav, Lehavy and Michaely (2005), use Value-Line and First Call analyst forecasts to proxy expected/required returns. Their motivation for using these data sources to obtain estimates of *ex ante* expected/required returns is as follows:

> Although market expectations are unobservable, there are several reasons to believe that our measures of expected return represent a significant portion of the market's expectations. First, the Value Line and First Call estimates that we use impact market prices (Affleck-Graves and Mendenhall, 1992 and Womack, 1996). Second, researchers and practitioners have been using analysts' earnings and growth forecasts as a proxy for the market's estimates of these variables. Third, subscribers to both databases (which include individual investors, brokerage and asset management firms, and corporations) have been paying for these services (directly or indirectly) and it is likely that they would adopt these expectations (Ang and Peterson, 1985). Fourth, coverage is wide for both databases. Finally, Value Line expectations are unlikely to suffer from incentives-related biases. Therefore, we use these expectations in our main tests.[19]

58 Brav et al (2005) collect expected return data primarily from Value Line, an independent research provider that covers approximately 3,800 US stocks. They analyse results for the period 1975-2001. Their sample comprises 92% of the NYSE, AMEX, and Nasdaq in terms of market value. They also use First Call as an additional source of analysts' expectations to create a large sample of analysts' expected returns. These expected returns are obtained from sell-side analysts for more than 7,000 firms during the period 1997 through 2001.

59 Their general approach is to infer the expected return from analyst forecasts of future dividends and target prices. Effectively, the expected return is estimated by solving for r_e in the following equation:

$$P_0 = \sum_{i=1}^{N} \frac{d_i}{(1+r_e)^{t_i}} + \frac{TP}{(1+r_e)^{t_{TP}}}$$

where:

- P_0 represents the current observable stock price;
- TP represents the analyst forecast of the stock price at some future time t_{TP}; and
- d_i represents the analyst forecast of the dividend to be paid at time t_i.

3.4.1 Key findings

60 Brav et al (2005) report that the same result that has been documented for observed *ex post* returns also holds with *ex ante* expected returns – the relationship

[19] Brav et al (2005), p. 32.

between beta and expected returns has a higher intercept and a flatter slope than the SL-CAPM would suggest. Indeed, Brav et al report that the result is even more pronounced with expected returns – the intercept is even higher than is the case with observed stock returns.

3.5 Analysis of *ex ante* returns in Australia

3.5.1 Data source and methodology

61 Since Value Line data is not available for Australia, we use the I/B/E/S analyst forecast database, which is comparable to the First Call data used by Brav et al (2005). Our sample covers the period March 2002 through to August 2017. All the data is collected via Thomson Reuters Datastream.

62 Analyst coverage increases significantly over this period, with 100 sample firms in March 2002 and 316 firms in August 2017. In total we have 1,199 firms over our 15-year sample period.

63 We follow the Brav et al (2005) methodology in analysing the Australian data, with the details of our approach set out in Appendix 2 to this report. This effectively involves the following cross-sectional regression specification being applied each month over the sample period:

$$\left(\hat{r}_e - r_f\right)_t = \alpha + \delta\hat{\beta}_t + \epsilon_t$$

where:

- $\left(\hat{r}_e - r_f\right)_t$ represents the analysts' expected excess return estimated at time t; and
- $\hat{\beta}_t$ represents the estimate of the firm's beta at time t.

64 Under the SL-CAPM, the regression intercept (α) would be zero and the slope coefficient (δ) would be equal to the market risk premium.

3.5.2 Results

65 Table 2 below documents the results from the regression described above performed on both an individual firm basis and a portfolio basis. These are estimates of expected excess returns and do not involve any realised returns. We have followed Brav et al (2005) in analysing and reporting *excess* returns – in excess of the prevailing risk-free rate. Thus, in the parlance of the ERA, the SL-CAPM posits an 'alpha' of zero and a slope equal to the market risk premium.

Table 2: Results for Australian sample compared with the results of Brav et al. (2005) and with values adopted by the ERA

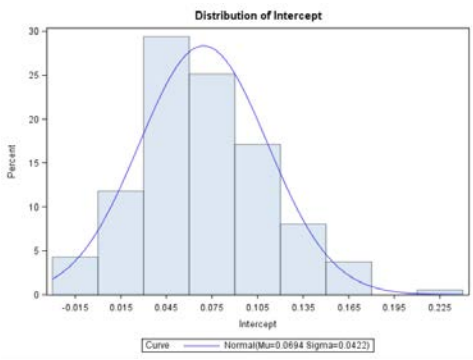
	ERA	Brav – Value Line	Brav – First Call	Individual Firm Level	Portfolio Level Decile	Portfolio Level Quintile
		US data		Australian data		
Intercept (Alpha)	0	0.07	0.20	0.07	0.07	0.07
(*t*-statistic)		(3.2)	(5.8)	(12.66)	(11.76)	(11.47)
Slope	0.06	0.07	0.07	0.01	0.01	0.01
(*t*-statistic)		(5.1)	(4.3)	(2.08)	(1.91)	(2.40)

Source: AER, Brav et al (2005), Datastream, Frontier Economics calculations. ERA allowances taken from Western Power Final Decision.

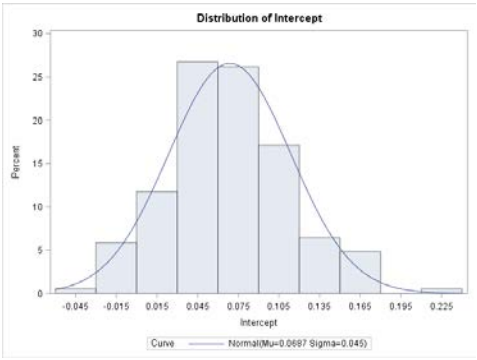
66 Table 2 demonstrates that the intercept terms (alpha) are positive and statistically significant (at more than the 1% level) in all cases. That is, the relationship between the expected return and beta estimates has a higher intercept than the SL-CAPM suggests (i.e., a positive 'alpha').

67 To ensure that the results are not driven by outliers, we examine the distribution of intercepts over time (an intercept is produced for the cross-sectional regression that is produced each month). The distributions of intercept terms for the various individual and portfolio specifications are set out in Figure 2 below. The intercept is consistently positive for almost every firm-year analysis, and the mean intercept (reported above) is highly statistically significant. That is, the distributions in Figure 2 show the intercept (alpha) terms for each of the analyses and Table 2 above shows that the mean of these intercept terms is highly statistically significant.

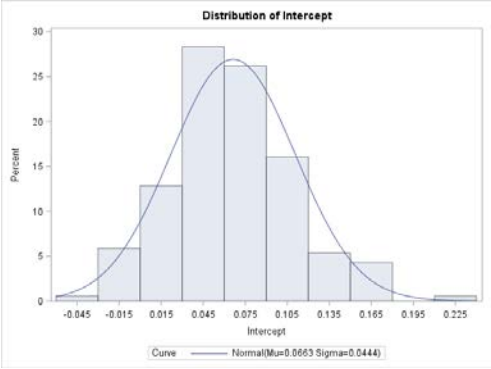
Figure 2: Distribution of intercepts for individual firm-level and portfolio time-series regressions for Australian data



Firm-level alphas



Portfolio alphas (deciles)



Portfolio alphas (quintiles)

Source: Frontier Economics calculations. These figures show the distribution of intercept estimates for each implementation of the regression in Paragraph 51 above. The bars represent the empirical distribution and the curve represents a normal distribution with mean and variance set equal to the empirical estimates from the distribution of intercepts. The figure shows that, in almost every case, the intercept is positive such that the expected return on low-beta stocks is higher than the SL-CAPM suggests.

3.5.3 Summary and conclusions from the Australian analysis

68 Testing of Australian data using the methodology employed by Brav et al. (2005) reveals a consistent and statistically significant intercept (alpha) term. This is consistent with the empirical evidence from observed returns. Both sets of evidence are inconsistent with the SL-CAPM.

69 In particular, we find that the intercept in the relationship between beta and *expected* stock returns is higher than the SL-CAPM would suggest. Thus, the expected return on low-beta stocks is higher than the SL-CAPM estimates.

70 These findings are consistent with the empirical evidence in relation to observed stock returns. They are also consistent with the US results for expected stock returns provided by the earlier study of Brav et al (2005).

3.6 The relevance of analyst forecasts

71 One of the key reasons for estimating *ex ante* expected returns using analyst forecasts and target prices is because that information has been shown to be strongly linked to value. Specifically, there is strong empirical evidence which shows that analysts' opinions affect prices (Womack, 1996, Barber, Lehavy, McNichols, and Trueman, 2001, and Brav and Lehavy, 2003).

72 Analysts, as a form of information intermediaries, are expected to mitigate information asymmetry and/or reveal mispricing. With access to a wide range of information, including public signals such as stock prices, industry news, and macroeconomic factors, as well as private signals about firm-specific financial and operating situation, analysts' outputs – for example, coverage decisions, earnings forecasts, and recommendations should contain valuable information for the capital markets and therefore have real economic consequences.

73 Kelly and Ljungqvist (2012) show that exogenous shocks to analyst coverage terminations through closures and/or brokerage mergers and acquisitions increase

firm expected returns by exacerbating adverse selection risk. Analyst coverage affects firm cost of capital and thus induces managers to change investment, and financing decisions (Derrien and Kecskés, 2013). Loh and Stulz (2018) show that analyst coverage decisions and recommendations become much more valuable in bad times.

74 The information content of analyst outputs increase with industry competition and becomes much more important to the functionality of the capital markets (Merkley, Michael and Pacelli, 2017). Das, Guo and Zhang (2006) show that analyst selective coverage decisions can predict future performances of newly listed firms. Lee and So (2017) extend the idea from Das, Guo and Zhang (2006) by applying a characteristic-based decomposition method to a large cross-section of firms find that the coverage signal related to analyst expectations about firm future performances, and show that the signal strongly predicts firm future returns and operating performances.

75 Asquith, Mikhail and Au (2005), Frankel, Kothari and Weber (2006), and Loh and Stulz (2011) show that analyst earnings revisions incorporate both publicly observed signals and new information to investors. Consequently, prices, trading activity, and liquidity all change around analysts' forecast revisions. Institutional investors trade more during the recommendation changes to capture the short-lived private information (Kadan, Michaely and Moulton, 2017). Studying intraday data, Bradley, Clarke, Lee and Ornthanalai (2014) find that the market reacts most strongly to analyst recommendation changes. Although analysts forecasts are known to exhibit inherent biases, So (2013) finds that investors in fact overweight them and the predictable biases influence the information content of prices. Hilary and Hsu (2013) find evidence that consistent analyst errors are more informative and more likely to affect prices than unbiased forecasts.

76 In summary, the literature on analyst forecasts indicates that there is some evidence of some biases in analyst forecasts, but those forecasts have a material impact on stock prices nevertheless. Thus, the analyst forecasts are relevant to market values.

77 Of course, when papers report some form of bias in analyst forecasts, that bias is relative to observed outcomes. Consequently, it would be illogical to hold the view that analyst forecasts do not represent market expectations because they diverge from outcome observed returns, if one also considered that observed returns do not reflect market expectations.

78 In other words, if one held the view that observed returns (on average) *do* reflect expected/required returns, we would not need analyst forecast data at all – we would use the more standard approach of using those observed returns as a proxy for expected/required returns.

79 Thus, if one considers that observed returns do reflect expected returns, we would just use observed returns and analyst forecasts would be irrelevant. If one considers that observed returns do not reflect expected returns, it would be illogical to compare analyst forecasts with those observed returns – because they don't reflect anything that is relevant.

4 What use can be made of the empirical evidence from observed stock returns?

4.1 The empirical evidence is well documented

80 The empirical evidence set out in Appendix 1 to this report, clearly establishes that the actual returns on low-beta stocks systematically and materially exceed the SL-CAPM estimates; a result that is known as low-beta bias. The feasible implementation of the SL-CAPM does not fit the observed data.

81 The literature documenting low-beta bias has been performed by the very top echelon of finance researchers, including two Nobel prize winners. Low beta bias has been consistently documented over several decades and across a number of markets and is documented in the standard finance textbooks.

4.2 The empirical evidence is well accepted

82 In the Australian regulatory setting, there is no debate about the empirical evidence of low-beta bias – it is agreed that the relationship between beta and observed returns has a higher intercept and a flatter slope than the SL-CAPM suggests. That is, there is broad agreement that the evidence shows that actual returns on low-beta stocks are systematically higher than the SL-CAPM would suggest.

83 For example, the ERA has recognised the empirical evidence:

> The Authority recognises that typical empirical applications of the Sharpe Lintner CAPM may under-estimate equity beta for low beta stocks, with the potential to lead to a downwards bias in the estimate of the return on equity.[20]

and:

> This evidence suggests that the [SL-CAPM] model tends to underestimate (overestimate) a return on equity for low-beta (high-beta) assets.[21]

4.3 Potential interpretation of the evidence

84 There are three ways of interpreting the evidence of low beta bias:

a. **Observed data can be used to estimate required returns**

One possibility is that real-world investors price low-beta stocks to earn expected returns that are higher than the SL-CAPM predicts, and that is reflected in the data. That is, the observed market data reflects the returns that investors actually require. This

[20] ERA, December 2013, Rate of return guideline: Explanatory statement: Appendices, p. 63.

[21] ERA, December 2013, Rate of return guideline: Explanatory statement: Appendices, p. 214.

interpretation would seem to be consistent with regulatory reliance on observed market data to estimate other parameters such as beta and MRP.

b. **Statistical problems with the econometric tests**

A second possibility is that the low-beta bias is only documented due to statistical problems with the econometric tests that have been applied. This explanation seems highly unlikely given the quality of the researchers involved (Black, Jensen, Scholes, Fama, MacBeth, etc.), the fact that the evidence has been documented in papers published in top journals spanning several decades, and the fact that the result is so well-accepted that it appears in standard textbooks.

c. **Random chance**

A third possibility is that real-world investors actually require a return in accordance with the SL-CAPM and price assets to yield that return in expectation, but that the actual returns have been higher than expected due to random chance. That is, investors in low-beta stocks require and expect a SL-CAPM return, but have received a higher return due to random chance. This explanation also seems highly unlikely given the persistence of the evidence over many decades and many different markets.

4.4 Regulatory interpretation of the empirical evidence

Interpretation of the evidence in the 2013 Guideline

85 In its 2013 Rate of Return Guideline, the ERA concluded in favour of the first interpretation above – that the observed data contains relevant information that the ERA should consider when setting the allowed return on equity. The ERA determined that this evidence would inform its selection of the allowed equity beta:

> …the Authority intends to account for empirical evidence relating to potential bias in the estimates of the equity beta, that are used in applying the Sharpe Lintner CAPM. The Authority considers that such an approach would account for much of the evidence supporting the use of the Empirical and Black CAPM models.[22]

86 The 'empirical CAPM' estimates the required return on equity based on the observed empirical relationship between beta and stock returns, rather than imposing the theoretical relationship. It is commonly used in US regulatory determinations. The Black CAPM is a theoretical model that has been derived to explain the systematic bias in the SL-CAPM.

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[22] ERA, December 2013, Rate of return guideline: Explanatory statement: Appendices, p. 69.

87 The ERA also stated that:

> …the Authority will take into account other relevant material when estimating the equity beta, such as insights from the empirical performance of the Sharpe Lintner CAPM. This evidence suggests that the model tends to underestimate (overestimate) a return on equity for low-beta (high-beta) assets.[23]

Interpretation of the evidence in the current Draft Guideline

88 As set out above, in its 2016 DBP Final Decision the ERA has changed its interpretation of the evidence in favour of the 'random chance' explanation – that investors may set their *ex ante* required returns on low-beta stocks exactly in accordance with the SL-CAPM, and that the *ex post* observed returns may have been systematically higher due to random chance.

89 In its recent Draft Guideline, the ERA has no regard to low-beta bias, so the statement in the DBP Final Decision in relation to *ex ante* versus *ex post* returns remains the ERA's latest statement on this issue.

4.5 Summary of regulatory positions

90 The position adopted by the ERA in its recent Draft Guideline is that the theoretical evidence from the Black CAPM and the empirical evidence of low-beta bias now have no role at all in the regulatory process. The main reasons for this position are:

a. The empirical evidence of low-beta bias uses observed (*ex post*) returns, which may differ from the *ex ante* expected return. That is, investors may have been expecting return on low-beta stocks to be consistent with the SL-CAPM and been surprised when actual returns have turned out to be systematically higher; and

b. The formal Black CAPM is not used explicitly in industry practice.

91 We examine the implications of this reasoning in the following sections of this report.

4.6 Equilibrium considerations

Three types of returns

92 The recent regulatory consideration of low-beta bias distinguishes between three different concepts of return:

a. The *required* return is the rate of return that investors require in order to provide capital;

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[23] ERA, December 2013, Rate of return guideline: Explanatory statement: Appendices, p. 216.

b. The *expected* return is the return that investors expect an investment to generate; and

c. The *observed* return is the return that an investment actually generates over a particular period.

Equilibrium and required vs expected returns

93 If the required return is equal to the expected return, the market is said to be 'in equilibrium' and investors will provide capital expecting to be properly compensated. Partington and Satchell (2017), correctly in our view, illustrate this point by drawing a distinction between expected returns and required returns. They note that disequilibrium is characterised by a situation in which the expected return differs from the required return. If investors are expecting an asset to deliver a return that is different from what they (in aggregate) require, the market is in disequilibrium and there will be a strong incentive for investors to trade. Partington and Satchell illustrate this point with an example:

> The equilibrium condition is reached by the adjustment of prices such that expected and required returns are equal. In Houston Kemp's example the required return on the stock is 10% and the expected return is 15%. This looks like a great deal for investors, they only require 10% but they expect to get 15%. Consequently, buying pressure is likely to push up the price of the stock until it has risen to a level where at the higher price it now offers a 10% return. It is, thus, the required return that determines equilibrium expected returns and the cost of capital.[24]

94 Partington and Satchell (2017) conclude that:

> We agree that in the absence of barriers to arbitrage there are strong forces that will equalise expected and required returns[25]

and we also agree with that conclusion for the reasons set out by Partington and Satchell. That is, there appears to be broad agreement that the market will generally be in equilibrium, where investors have priced stocks such that the expected return is equal to their required return.

95 Consequently, we agree with Partington and Satchell (2017) that it is appropriate to consider the *expected* return to be equal to the *required* return – that investors have priced stocks such that they expect to receive a return equal to that which they require.

Expected vs observed returns

96 Partington and Satchell (2017) go on to draw the same distinction between *ex ante* expected/required returns and *ex post* observed returns as the ERA has raised above:

> We agree that in the absence of barriers to arbitrage there are strong forces that will equalise expected and required returns. We do not however agree with the implication

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[24] Partington and Satchell (2017), p. 28.

[25] Partington and Satchell (2017), p. 27.

> that given equality between expected and required returns all will be well in using realised returns to measure expected returns period by period. Even if expected and required returns are equal, there can be persistent differences between realised returns and equilibrium expected returns.[26]

97 That is, even when a market *is* in equilibrium (so that investors expect to receive the return they require) it is still possible that the observed return over some period may differ from the required/expected return.

98 There are a number of economic models that characterise the returns that investors require/expect in equilibrium. One of these is the SL-CAPM, but there are others, such as Black (1972) and Hong and Sraer (2016), that produce estimates of the required/expected return that differ from the SL-CAPM estimates.

99 Now suppose that we select one of the available equilibrium models (the ERA has selected the SL-CAPM) and we observe that actual returns are systematically inconsistent with the expected returns produced by that model in some respect (e.g., higher intercept and flatter slope). There are two potential explanations:

a. The selected model does not perfectly describe the process by which the aggregate market determines required returns; or

b. The selected model *does* perfectly describe the process by which the aggregate market determines required returns, but the actual returns over the period that was examined happened to deviate from the return that investors required/expected due to random chance.

Consideration of alternative explanations

100 We noted above that the difference between the modelled expected returns and observed returns is either:

a. because the model is not a perfect description of expected returns; or

b. because the data does not properly reflect expected returns.

101 Partington and Satchell (2017) observe that the relative weight to be applied to the selected model versus the observed data will depend on a number of factors. For example:

a. A model is more likely to properly describe the process by which the aggregate market determines required returns if it is rigorously derived from a set of plausible assumptions; and

b. One would have more confidence that an empirical result is a real effect, and not due to random chance, if it was consistently documented over a long period of time, and in different markets,

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[26] Partington and Satchell (2017), p. 27.

by leading researchers, in the very top journals, and appeared in the standard textbooks.

102 In the case at hand, the SL-CAPM is the simplest of all equilibrium asset pricing models – the expected return is modelled by adding one parameter to the product of two others. Since the SL-CAPM was developed in the 1960s, the literature has moved on and there is now a rich collection of models that have been designed to expand upon the simple starting point.

103 By contrast, the empirical evidence in Appendix 1 is the most consistent, compelling and well-accepted empirical evidence in the field of asset pricing. The contributors to this literature include two Nobel Prize winners and the studies documenting low-beta bias have been published in the very top finance journals over several decades, and the empirical evidence of low-beta bias is so well-accepted that it appears in the standard finance textbooks.

104 It is, of course, theoretically possible that investors set required/expected returns exactly in line with the 1960s SL-CAPM (and exactly in line with the way the ERA implements it) and that the decades of empirical evidence of low-beta bias has occurred by random chance. However, the consistency, strength and quality of the evidence of low-beta bias, and the fact that it is so well-accepted that it appears in the standard finance textbooks, suggests that it would be quite unreasonable to conclude that it has occurred by random chance.

105 The literature since the documentation of low-beta bias has not questioned whether or not the empirical evidence is a real reflection of the returns that investors require/expect. Rather, the literature has focused on identifying what it is about the simple SL-CAPM, and the assumptions that underpin it, that leads to it systematically understating the returns on low-beta stocks.

4.7 The development of the relevant academic literature

4.7.1 Black (1972)

106 Over the years since low-beta bias was first documented, the finance literature has continued to confirm the existence of low-beta bias and has focussed on identifying why the SL-CAPM systematically understates the returns on low-beta stocks. For example, Black (1972) summarises some of this literature as follows:

> …several recent studies have suggested that the returns on securities do not behave as the simple capital asset pricing model described above predicts they should. Pratt analyzes the relation between risk and return in common stocks in the 1926-60 period and concludes that high-risk stocks do not give the extra returns that the theory predicts they should give.
>
> Friend and Blume use a cross-sectional regression between risk-adjusted performance and risk for the 1960-68 period and observe that high-risk portfolios seem to have poor performance, while low-risk portfolios have good performance.

> …Black, Jensen, and Scholes analyze the returns on portfolios of stocks at different levels of β_i in the 1926-66 period. They find that the average returns on these portfolios are not consistent with equation (1) [the Sharpe-Lintner CAPM], especially in the postwar period 1946-66. Their estimates of the expected returns on portfolios of stocks at low levels of β_i are consistently higher than predicted by equation (1), and their estimates of the expected returns on portfolios of stocks at high levels of β_i are consistently lower than predicted by equation (1).[27]

107 In trying to develop a conceptual rationale for this consistent empirical finding, Black (1972) focuses on one of the assumptions that underpins the derivation of the SL-CAPM – that all investors can borrow or lend as much as they like at the risk-free rate. He states that:

> One possible explanation for these empirical results is that assumption (d) of the capital asset pricing model does not hold. What we will show below is that the relaxation of assumption (d) [all investors can borrow or lend as much as they like at the risk-free rate] can give models that are consistent with the empirical results obtained by Pratt, Friend and Blume, Miller and Scholes, and Black, Jensen and Scholes.[28]

108 That is, Black (1972):

a. Notes that there is consistent evidence about the empirical failings of the SL-CAPM – the empirical evidence suggests that the relationship between beta and returns has a higher intercept and a flatter slope than the SL-CAPM would suggest; and

b. Considers what it is about the SL-CAPM that causes it to produce estimates that are systematically different from the observed data. Black (1972) concludes that a driving problem is the SL-CAPM assumption that all investors can borrow and lend unlimited amounts at the same risk-free rate.

4.7.2 Fama and French (1996)

109 More recent papers continue to document the existence of low-beta bias and to develop models that better fit the observed stock returns. The literature accepts that the empirical evidence is a real reflection of the returns that investors require/expect. It then notes that this evidence presents a problem for the SL-CAPM.

110 For example, Fama and French (1996) examine the relationship between beta and observed stock returns in extensive empirical tests spanning decades. They document that the data is unable to reject the null hypothesis that beta is unrelated to stock returns.[29] They go on to document other problems with the SL-CAPM and conclude that:

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[27] Black (1972), p. 445.

[28] Black (1972), p. 445.

[29] Fama and French (1996), Table 1, Panel B, p. 1951.

> In our view, the evidence that β does not suffice to explain expected return is compelling. The average return anomalies of the CAPM are serious enough to infer that the model is not a useful approximation.[30]

4.7.3 Frazzini and Pederson (2014)

111 The more recent literature has focused on identifying and correcting the aspects of the SL-CAPM that causes it to systematically understate the returns on low-beta stocks.

112 For example, Frazzini and Pederson (2014) also note the body of evidence:

> Indeed, the security market line for U.S. stocks is too flat relative to the CAPM (Black, Jensen, and Scholes, 1972) and is better explained by the CAPM with restricted borrowing than the standard CAPM (Black, 1972, 1993, Brennan, 1971). See Mehrling (2005) for an excellent historical perspective. [31]

113 They then focus on the real-world leverage restrictions that investors face that impinge on the theoretical premise of the SL-CAPM – that all agents invest in the portfolio with the highest expected excess return per unit of risk and leverage or de-leverage this portfolio to suit their risk preferences. They rule out the possibility that the empirical relationship is caused by the market pricing idiosyncratic risk, preferring the 'constrained borrowing' explanation:

> Our results shed new light on the relation between risk and expected returns. This central issue in financial economics has naturally received much attention. The standard CAPM beta cannot explain the cross section of unconditional stock returns (Fama and French, 1992) or conditional stock returns (Lewellen and Nagel, 2006). Stocks with high beta have been found to deliver low risk-adjusted returns (Black et al., 1972, Baker et al., 2011); thus, the constrained-borrowing CAPM has a better fit (Gibbons, 1982, Kandel, 1984, Shanken, 1985). Stocks with high idiosyncratic volatility have realized low returns (Falkenstein, 1994, Ang et al., 2006, Ang et al., 2009), but we find that the beta effect holds even when controlling for idiosyncratic risk.

4.7.4 Liu, Stambaugh and Yuan (2018)

114 Liu, Stambaugh and Yuan (2018) also start by noting the large and well-accepted body of evidence:

> The beta anomaly [low-beta bias] is perhaps the longest-standing empirical challenge to the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965) and asset-pricing models that followed. Beginning with the studies of Black et al. (1972) and Fama and MacBeth (1973), the evidence shows that high-beta stocks earn too little compared to low-beta stocks. In other words, stocks with high (low) betas have negative (positive) alphas. [32]

115 They then examine the possible cause of mispricing under the SL-CAPM, with a focus on omitted factors.

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[30] Fama and French (1996), p. 1957.

[31] Frazzini and Pederson (2014), "Betting against beta," *Journal of Financial Economics* 111, 1-25, p.2.

[32] Liu, Stambaugh and Yuan, 2018, "Absolving beta of volatility's effects," *Journal of Financial Economics*, 128, 1-15 at p. 1.

4.7.5 Hong and Sraer (2016)

116 The recent literature has also extended to the development of new equilibrium asset pricing models that relax certain restrictive assumptions of the SL-CAPM and derive an equilibrium that is more consistent with the observed data. For example, Hong and Sraer (2016) also begin by confirming the large body of empirical evidence:

> There is compelling evidence that high-risk assets often deliver lower expected returns than low-risk assets. This is contrary to the risk-return trade-off at the heart of neoclassical asset pricing theory. The high-risk, low-return puzzle literature, which dates back to Black (1972) and Black, Jensen, and Scholes (1972), shows that low-risk stocks, as measured by a stock's comovement with the stock market or Sharpe's (1964) capital asset pricing model (CAPM) beta, have significantly outperformed high-risk stocks over the last 30 years. Baker, Bradley, and Wurgler (2011) further show that since January 1968 the cumulative performance of stocks has actually been declining with beta.[33]

117 Their focus is on relaxing two unrealistic assumptions that underpin the SL-CAPM. First, rather than assuming, as the SL-CAPM does, that investors face no constraints to trading, they assume some investors face short-sale constraints. Second, rather than assuming, as the SL-CAPM does, that investors all have the same beliefs, they assume that investors hold differing beliefs. They conclude that it may be these SL-CAPM assumptions that cause it to systematically understate the returns on low-beta stocks.

118 The AER briefly considers Hong and Sraer (2016) in its 2018 Draft Guideline Explanatory Statement.[34] The AER appears to recognise that the Hong and Sraer model is an equilibrium asset pricing model that does produce outcomes that are more consistent with the observed data – it is empirically superior to the SL-CAPM.

119 The AER's Explanatory Statement then focuses on the question of whether the Hong and Sraer model should replace the SL-CAPM as the AER's 'foundation model.' The AER concludes that the Hong and Sraer should not be used as the foundation model because there is no evidence of it being used by market practitioners and because the AER has some concerns about the econometric analysis.

120 Both of these issues are debatable,[35] but are beside the point. The key point is that the Hong and Sraer model has not been proposed as an alternative to the SL-

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[33] Hong, H. and D. Sraer, 2016, "Speculative Betas," *Journal of Finance*, 71(5), 2095-2144, p. 2095.

[34] AER, July 2018, Draft Rate of Return Guideline, pp. 286-287.

[35] For example, whereas there is no evidence of practitioners citing Hong and Sraer (2016) specifically, there is extensive evidence of practitioners using an intercept (or alpha) above that of the SL-CAPM, as set out in Section 4.8 below. Certainly, there is very little evidence of practitioners implementing the SL-CAPM in the way the AER and ERA implement it. In relation to the econometric analysis, we note that the AER cites that Hong and Sraer remove very small and very low-priced stocks from their data set. This is a common practice in the relevant literature. The AER does not explain *why* this standard practice is of concern to them. We note that the paper has gone through the peer review process and been published in the world's leading finance journal.

CAPM. Rather, it is cited as an example of an equilibrium model that *is* consistent with the observed data in a way that the SL-CAPM is not. It is a clear example of how the literature has moved on since the SL-CAPM was developed in the 1960s. It shows that the evidence of low-beta bias is accepted as a given fact and researchers are no longer questioning whether or not it is real, but are seeking to determine what it is about the SL-CAPM that causes it to systematically understate the returns on low-beta stocks and to correct those deficiencies.

4.7.6 Asness et al (2018)

121 In an even more recent paper, Asness, Frazzini, Gormsen and Pedersen (2018) also begin by confirming the systematic empirical evidence:

> One of the major stylized facts on the risk-return relation, indeed in empirical asset pricing more broadly, is the observation that assets with low risk have high alpha, the so-called "low-risk effect" (Black, Jensen, and Scholes, 1972).
>
> Hence, the systematic low-risk effect is based on a rigorous economic theory and has survived more than 40 years of out of sample evidence.[36]

122 They focus on identifying which limitations of the SL-CAPM are responsible for the effect. For instance, whether the constraints on leverage, which exist in the real world but not in the SL-CAPM, are driving the effect or whether it is idiosyncratic risk (again ignored in the SL-CAPM) driving the effect.

123 We note that this issue is of more than mere academic interest. Asness and Pedersen are principals of AQR Capital Management that are responsible for investing more than $200 billion of investors' funds.

4.7.7 Australian evidence

124 SFG (2013)[37] evaluate Australian data and document a higher intercept and flatter slope than the SL-CAPM suggests. Specifically, the intercept in the relationship between beta and returns is shown to be approximately 3% above the SL-CAPM intercept.

125 Truong and Partington (2007)[38] also evaluate the CAPM, and variations of the dividend growth model, using Australian data. They conduct a range of analyses whereby actual returns are compared with the SL-CAPM estimate.[39] In every analysis the intercept is significantly positive and the slope is flatter than the SL-CAPM suggests. They also begin by noting the consensus that has developed in the literature:

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[36] Asness, Frazzini, Gormsen and Pedersen 2018, "Betting Against Correlation: Testing Theories of the Low-Risk Effect" CEPR Discussion Paper No. DP12686, p.2.

[37] SFG, 2013, Beta and the Black Capital Asset Pricing Model, 13 February.

[38] Truong, G. and G. Partington, 2007, Alternative estimates of the cost of equity capital for Australian firms, University of Sydney.

[39] Truong and Partington (2007), Tables 4 and 5, pp. 43-45.

> Although the CAPM emerges as the most popular model among practitioners, empirical tests show evidence of its disappointing performance. The cost of capital estimated using the CAPM does a poor job in explaining the variation of future stock returns (Fama and French, 1992, 1993).[40]

126 They go on to note that their results show that the SL-CAPM performs particularly poorly when assessed against the Australian data:

> The estimates from the CAPM are negatively correlated with one year ahead returns but demonstrate no significant association with two and three year ahead returns as shown in Panels A and B of Table 4. This finding is consistent with evidence of the poor performance of the CAPM generally found in previous empirical examinations of the model.[41]

127 They conclude that the vanilla SL-CAPM has no useful role in producing cost of capital estimates that have any relationship to actual stock returns, and that the DGM approach is superior:

> However, in this study, as in previous studies, the CAPM produces cost of capital estimates that have little ability to explain cross-sectional variations in future stock returns. There is a growing literature on the use of valuation models to estimate the implied cost of capital. This study using data from the Australian market contributes further empirical evidence to the literature in this area. Using both the CAPM and four valuation models, the cost of capital for a sample of Australian firms is estimated for the period from 1995 to 2004. Estimates from the models are evaluated based on their ability to explain the variation of future stock returns and their association with firm characteristics. The CAPM fails dismally in regard to the same criterion.[42]

4.7.8 Summary of developments in the academic literature

128 The key points made in this section of the report are that:

a. The empirical evidence of low-beta bias has been consistently confirmed over a number of decades. The literature continues to show that the relationship between beta and observed returns has a higher intercept and a flatter slope than the SL-CAPM suggests.

b. The literature considers the effect to be real and has moved on to identifying what it is about the SL-CAPM, and the assumptions that underpin it, that leads to it systematically understating the returns on low-beta stocks.

c. The issue is of real interest to leading investment managers.

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[40] Truong and Partington (2007), p. 2.

[41] Truong and Partington (2007), p. 25.

[42] Truong and Partington (2007), p. 33.

4.8 Evidence of market practice

4.8.1 Overview

129 We have noted above that there is consistent empirical evidence that the relationship between beta and observed returns has a higher intercept and a flatter slope than the SL-CAPM suggests. One question that then arises is whether market practitioners, when estimating required returns, adopt a higher intercept (and therefore a flatter slope) to be consistent with the observed evidence. The raw SL-CAPM sets the intercept equal to the prevailing risk-free rate, which is usually estimated as the yield on government bonds.

130 Thus, the question is whether there is evidence of market practitioners implementing the CAPM using an intercept above the prevailing government bond yield. In this section, we demonstrate that there is evidence that independent experts and market practitioners commonly use an intercept above the prevailing government bond yield.

4.8.2 Independent experts

131 In its recent Guideline materials, the AER has noted the evidence that it is common for independent expert valuation reports to adopt an intercept above the prevailing government bond yield – consistent with the empirical evidence.[43]

132 For example, a recent KPMG report explains that:

> The risk free rate of return is the return on a risk free security, typically for a long-term period. In practice, long dated Government bonds are accepted as a benchmark for a risk free security. In Australia, the 10 year Commonwealth Government bond yield is commonly referenced, of which the spot yield was 2.63% as at 30 June 2018.
>
> However, since the global financial crisis in 2008, Government bond yields have remained low compared to long-term averages. Combined with market evidence which indicates that bond yields and the market risk premium are strongly inversely correlated, it is important that any assessment of the risk free rate should be made with respect to the position adopted in deriving the market risk premium. In this regard, KPMG Corporate Finance has adopted a long-term historical market risk premium as a proxy for the expected market risk premium and applied a higher risk free rate than the spot yield of the 10 year Commonwealth Government bond yield.
>
> We have adopted 3.9% as an appropriate risk free rate, which represents a blend of the spot rate and a forecast long-term bond yield of 4.15%.[44]

133 As another example, a recent Grant Thornton report explains that:

> We note that the current spot yield is approximately 2.9%. However, given that the US Federal Reserve has raised the cash rates five times in the last 18 months, including on 14 June 2018 to between 1.75% to 2.00% and has signalled further increases over

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[43] AER, July 2018, Draft rate of return Guidelines: Explanatory Statement, pp. 206-207.

[44] KPMG, Independent Expert Report for Oroton Group Ltd, 5 July 2018, p.84.

> the next two years we have assessed a long-term risk free rate of c.3.5%. This is also consistent with forward rates and future yield curve.[45]

134 The KPMG Valuation Practice survey reports that 82% of respondents 'always' or 'often' apply an intercept above the prevailing risk-free rate.[46]

4.8.3 Survey respondents

135 The most recent surveys cited in the AER's Draft Guideline are those of Fernandez (2017, 2018) and KPMG (2017). In all cases, the relevant practitioners report using an intercept above the prevailing government bond yield – consistent with the empirical evidence.

136 For example:

a. Fernandez (2017, p. 4) reports that the median respondent adopts an intercept of 3.1% at a time when the prevailing 10-year government bond yield was 2.6%.

b. Fernandez (2018, p. 4) reports that the median respondent adopts an intercept of 3.0% at a time when the prevailing 10-year government bond yield was 2.7%.

c. KPMG (2017, p. 10) reports that the median respondent adopts an intercept in the range of 3.0% to 3.5% at a time when the prevailing 10-year government bond yield was 2.6%.

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[45] Grant Thornton, Independent Expert Report for Sino Gas & Energy Holdings Ltd, 26 July 2018, p.75.

[46] KPMG, 2017, KPMG valuation practices survey, p. 13.

5 Conclusions

Framework

137 In this report, we take the ERA's current position as the starting point:

a. That any problem to be remedied relates to the model itself and not to the empirical estimates of beta; and

b. That there is insufficient evidence of a low beta-bias in *expected* returns, because the evidence focuses on *observed* returns and it may be the case that actual returns have systematically different from what investors required or expected.

Ex ante expected returns

138 The literature demonstrates that the *ex ante* required returns produce the same result that has been documented for *ex post* observed returns – the relationship between beta and required returns has a higher intercept and a flatter slope than the SL-CAPM would suggest.

139 We have applied this methodology to Australian data and we also find the same result – the relationship between beta and *ex ante* expected returns has a higher intercept and a flatter slope than the SL-CAPM would suggest.

Observed returns

140 There are two potential explanations for the fact that observed returns on low-beta stocks are systematically higher than the SL-CAPM suggests:

a. The selected model does not perfectly describe the process by which the aggregate market determines required returns; or

b. The selected model *does* perfectly describe the process by which the aggregate market determines required returns, but the actual returns over the period that was examined happened to deviate from the return that investors required/expected due to random chance.

141 When assessing the reasonableness of the ERA's approach of placing 100% faith in the SL-CAPM and applying 0% weight to the empirical evidence, the relevant considerations include:

a. The empirical evidence of low-beta bias is the most consistent, compelling and well-accepted empirical evidence in the field of asset pricing. The contributors to this literature include two Nobel Prize winners and the studies documenting low-beta bias have been published in the very top finance journals over several decades, and the empirical evidence of low-beta bias is so well-accepted that it appears in the standard finance textbooks; and

b. The literature since the documentation of low-beta bias has not questioned whether or not the empirical evidence is a real

reflection of the returns that investors require/expect. Rather, the literature has focused on identifying and modifying the components of the SL-CAPM that lead to it systematically understating the returns on low-beta stocks.

Market practice

142 There is evidence that independent experts and market practitioners commonly use an intercept above the prevailing government bond yield.

The evidence is relevant and robust and should not be disregarded

143 We have been asked to provide a view on the binary qualitative question of whether the empirical evidence of low-beta bias and the theoretical evidence of the Black CAPM should have a real role in the process for estimating the required return on equity. In our view, there are compelling reasons to have real regard to that evidence if the goal is to produce the best possible estimate of the required return on equity.

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7 Appendix 1: The empirical evidence of low-beta bias

7.1 Overview

144 Soon after the publication of the Sharpe-Lintner CAPM, researchers began testing whether the predictions (or, more precisely, the empirical implications) of the model were supported in real-world data. The conclusion from this evidence is that the empirical implementation of the SL-CAPM provides a poor fit to the observed data. In particular, the actual returns on low-beta stocks systematically and materially exceed the SL-CAPM estimates; a result that is known as low-beta bias. The feasible implementation of the SL-CAPM does not fit the observed data.

145 The literature documenting low-beta bias has been performed by the very top echelon of finance researchers, including two Nobel prize winners. Low beta bias has been consistently documented across a number of markets and is documented in the standard finance textbooks. The relationship between beta and returns has a higher intercept and a flatter slope than the SL-CAPM suggests.

146 The remainder of this section summarises some of the relevant body of evidence.

7.2 Black, Jensen and Scholes (1972)[47]

147 A number of empirical tests are based on the following rearranged version of the SL-CAPM equation:

$$r_e - r_f = (r_m - r_f)\beta_e .$$

148 For example, Black, Jensen and Scholes (1972) construct tests of the model in the form of the following regression specification:[48]

$$r_{e,j} - r_{f,j} = \gamma_0 + \gamma_1 \beta_{e,j} + u_j .$$

149 The SL-CAPM implies that $\gamma_0 = 0$ and $\gamma_1 = r_m - r_f$. However, a series of studies including Black, Jensen and Scholes (1972) report that the intercept of this regression model is higher than the SL-CAPM would suggest $(\gamma_0 > 0)$ and the slope is flatter than the SL-CAPM would suggest $(\gamma_1 < r_m - r_f)$. For example, Black Jensen and Scholes (1972) state that:

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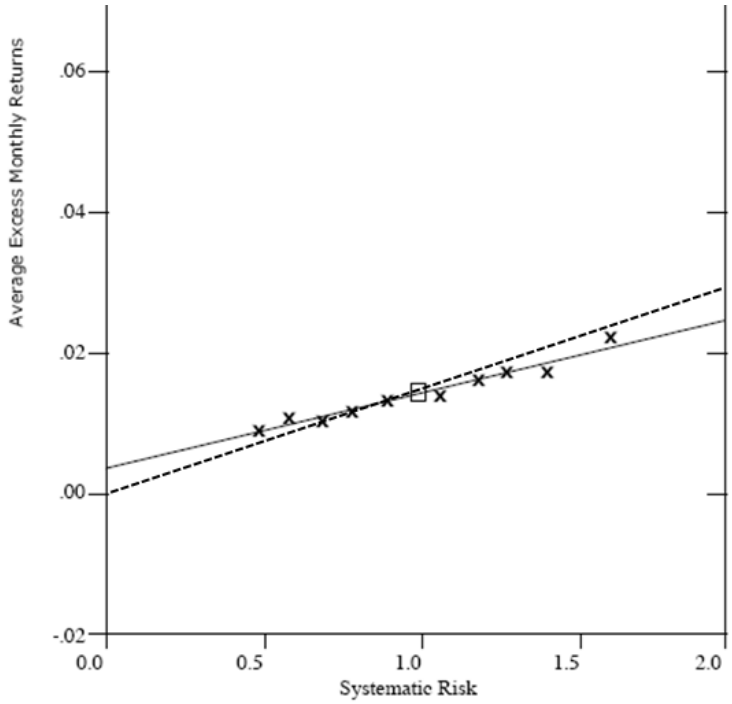
[47] Black, F., M.C. Jensen, and M. Scholes, 1972, "The Capital Asset Pricing Model: Some empirical tests," in *Studies in the Theory of Capital Markets,* Michael C. Jensen, ed., New York: Praeger, 79–121.

[48] See, for example, Black, Jensen and Scholes (1972), p. 3.

> The tests indicate that the expected excess returns on high beta assets are lower than (1) [the Sharpe-Lintner CAPM equation] suggests and that the expected excess returns on low-beta assets are higher than (1) suggests.[49]

150 The main result of Black, Jensen and Scholes (1972) is summarised in Figure 3 below. In that figure, the dashed line represents the security market line[50] that is implied by the SL-CAPM and the grey line represents the best fit to the empirical data. The data suggests that the intercept is too high and the slope is too flat to be consistent with the SL-CAPM.

Figure 3: Results of Black, Jensen and Scholes (1972)



Source: Black, Jensen and Scholes (1972), Figure 1, p. 21. Dashed line for Sharpe-Linter CAPM has been added.

151 Black, Jensen and Scholes (1972) go on to define the intercept of the empirical regression line to be R_z. They report that the intercept over their sample period of 1931 to 1965 was approximately 4% above the theoretical SL-CAPM intercept.[51] They go on to conclude that:

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[49] Black, Jensen and Scholes (1972), p. 4.

[50] The term "security market line" refers to the linear relationship between beta and expected returns for individual assets or portfolios of assets. In empirical analysis this is typically measured as the line of best fit between beta estimates and realised returns for individual assets or portfolios of assets.

[51] Table 5, p. 38 reports a monthly zero beta premium of 0.338% per month, which is approximately equivalent to 4% per year.

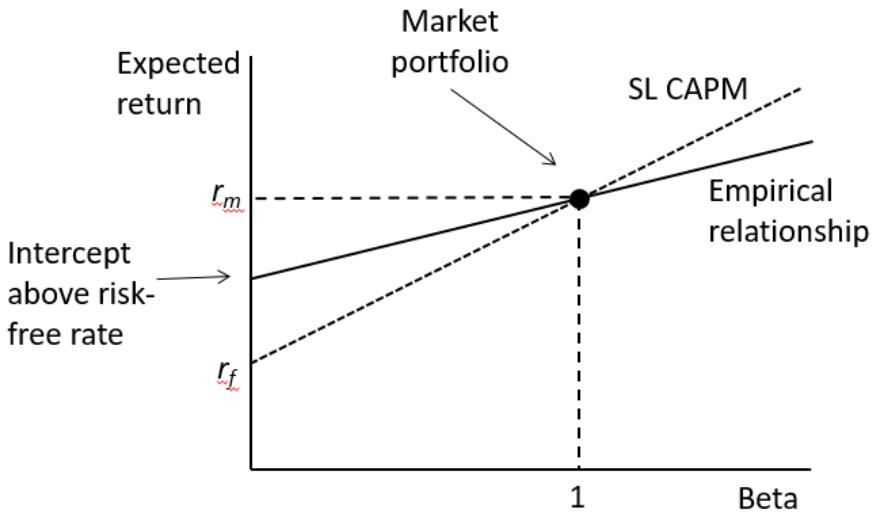
> These results seem to us to be strong evidence favoring rejection of the traditional form of the asset pricing model which says that Rz should be insignificantly different from zero.[52]

and that:

> These results indicate that the usual form of the asset pricing model as given by (1) [the SL-CAPM] does not provide an accurate description of the structure of security returns.[53]

152 The empirical relationship and the implications of the SL-CAPM are contrasted in Figure 4, which shows the SL-CAPM in its usual form. (Note that in Figure 3 Black, Jensen and Scholes (1972) show *excess* returns, after subtracting the risk-free rate.)

Figure 4: Sharpe-Lintner CAPM vs. observed empirical relationship.



7.3 Friend and Blume (1970)[54]

153 Friend and Blume (1970) define the abnormal return (the Greek letter "eta" or η) to be the observed excess return of a stock (or portfolio) less the expected return from the SL-CAPM:[55]

$$\eta_i = (r_e - r_f) - (r_m - r_f)\beta_e .$$

154 Under the SL-CAPM, η_i should be zero on average and it should be independent of beta. However, Friend and Blume (1970) report a systematic relationship between the abnormal return and beta – *low-beta* stocks generate *higher* returns than

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[52] Black, Jensen and Scholes (1972), p. 39.

[53] Black, Jensen and Scholes (1972), pp. 3–4.

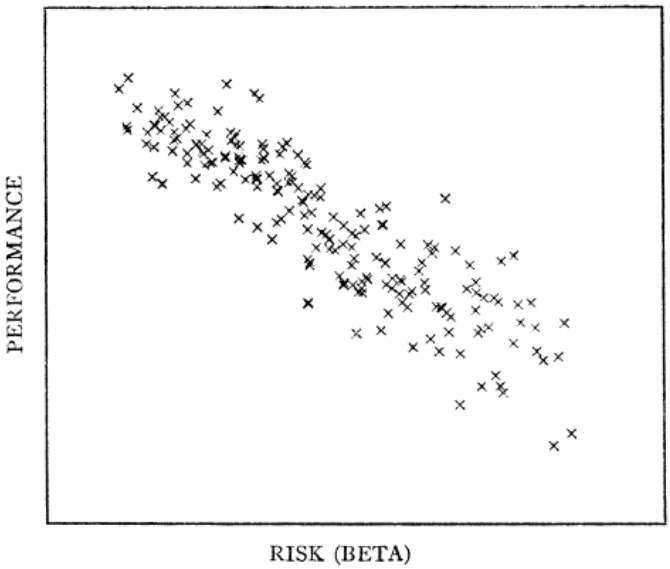
[54] Friend, I., and M. Blume, 1970, "Measurement of portfolio performance under uncertainty," *American Economic Review*, 60, 561–75.

[55] Friend and Blume (1970), p. 563.

the SL-CAPM would suggest and *high-beta* stocks tend to generate *lower* returns than the SL-CAPM would suggest. This relationship is shown clearly in Figure 5 below. Friend and Blume note that:

> The absolute values of the performance measures are in excess of market expectations for funds with Beta coefficients below one and below expectations for higher coefficients. [56]

Figure 5: The relationship between abnormal returns and beta



Source: Friend and Blume (1970), p. 567.

155 Friend and Blume (1970) go on to consider what it is about the SL-CAPM that results in it providing such a poor fit to the observed data. They conclude that the most likely source of the problem is the assumption that all investors can borrow or lend as much as they like at the risk-free rate:

> Of the key assumptions underlying the market theory leading to one-parameter measures of performance, the one which most clearly introduces a bias against risky portfolios is the assumption that the borrowing and lending rates are equal and the same for all investors. Since the borrowing rate for an investor is typically higher than the lending rate, the assumption of equality might be expected to bias the one-parameter measures of performance against risky portfolios because, for such portfolios, investors do not have the same option of increasing their return for given risk by moving from an all stock portfolio to an investment with additional stock financed with borrowings at the lending rate.[57]

[56] Friend and Blume (1970), p. 569.

[57] Friend and Blume (1970), p. 569.

7.4 Fama and MacBeth (1973)[58]

156 Fama and MacBeth (1973) use the following regression specification:[59]

$$r_{e,j} = \gamma_0 + \gamma_1 \beta_{e,j} + u_j .$$

157 Under this specification, the SL-CAPM implies that $\gamma_0 = r_f$ and $\gamma_1 = r_m - r_f$. Fama and Macbeth (1973) note that previous empirical work has demonstrated violations of both of these implications of the SL-CAPM:

> The work of Friend and Blume (1970) and Black, Jensen, and Scholes (1972) suggests that the S-L hypothesis is not upheld by the data. At least in the post-World War II period, estimates of $E[\tilde{\gamma}_{0t}]$ seem to be significantly greater than R_{ft}.[60]

158 Fama and Macbeth (1973) then test the hypothesis that $\gamma_0 - r_f = 0$ on average. They reject that hypothesis in their data and conclude that:

> Thus, the results in panel A, table 3, support the negative conclusions of Friend and Blume (1970) and Black, Jensen, and Scholes (1972) with respect to the S-L hypothesis.[61]

7.5 Fama and French (2004)[62]

159 The consistent results in the studies reviewed above are not unique to the data from the periods examined in those studies. Rather, the results have proven to be consistent through time – low-beta stocks generate higher returns than the SL-CAPM would imply and high-beta stocks earn lower returns than the SL-CAPM would imply. With respect to the early tests of the SL-CAPM, Fama and French (2004) summarise the state of play as:

> The early tests firmly reject the Sharpe-Lintner version of the CAPM. There is a positive relation between beta and average return, but it is too "flat."

160 Fama and French (2004) then provide an updated example of the evidence using monthly returns on U.S.-listed stocks over 76 years from 1928 to 2003. This analysis is summarised in Figure 6 below. Consistent with the early evidence, realised returns on low-beta stocks are higher than predicted by the SL-CAPM, and realised returns on high-beta stocks are lower than predicted by the SL-CAPM. Stocks with the lowest beta estimates (approximately 0.6) had average returns of 11.1% per year, whereas the SL-CAPM estimate of the expected return was only

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[58] Fama, E.F., and J.D. MacBeth, 1973, "Risk, return, and equilibrium: Empirical tests," *Journal of Political Economy*, 81, 607–636.

[59] See Fama and MacBeth (1973), p. 611.

[60] Fama and MacBeth (1973), p. 630.

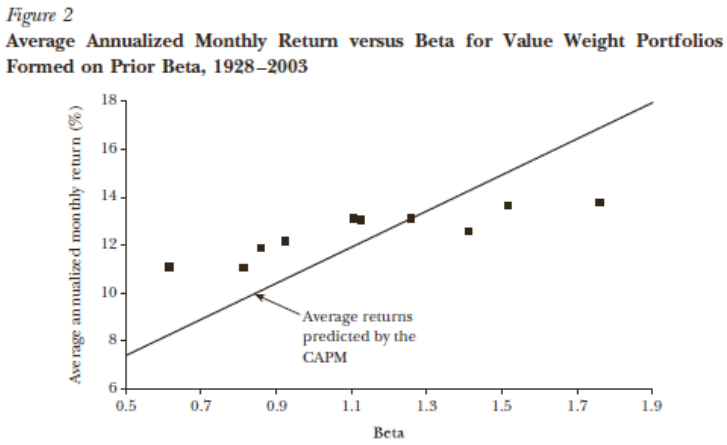
[61] Fama and MacBeth (1973), p. 632.

[62] Fama, E.F., and K. French, 2004, "The Capital Asset Pricing Model: Theory and evidence," *Journal of Economic Perspectives*, 18, 25–46.

8.3% per year. Stocks with the highest beta estimates (approximately 1.8) had average returns of 13.7% per year, whereas the SL-CAPM estimate of the expected return was 16.8% per year.

161 Again the actual relationship between beta and returns has a higher intercept and a flatter slope than the SL-CAPM suggests.

Figure 6. Average returns versus beta over an extended time period



Source: Fama and French (2004), p. 33.

7.6 Brealey, Myers and Allen (2011)[63]

162 The evidence of low-beta bias has been so consistent and well-accepted that it is now discussed in standard finance courses and textbooks. For example, Brealey, Myers and Allen (2011), one of the leading finance textbooks, extend the previous analysis another four years to the end of 2008, and provide a similar chart to that presented by Fama and French (2004), but with excess returns on the vertical axis. This chart is presented Figure 7 below. The line represents the relationship between beta and excess return that is implied by the SL-CAPM and each dot represents the observed return for a particular portfolio. Consistent with all of the evidence set out above, the low-beta portfolios still earn higher returns than the SL-CAPM would imply.

163 The pattern of a higher intercept and a flatter slope than the SL-CAPM suggests is again obvious.

[63] Brealey, R.A., S.C. Myers, and F. Allen, 2011, *Principles of Corporate Finance,* 10th ed., McGraw-Hill Irwin.

Figure 7: The relationship between excess returns and beta

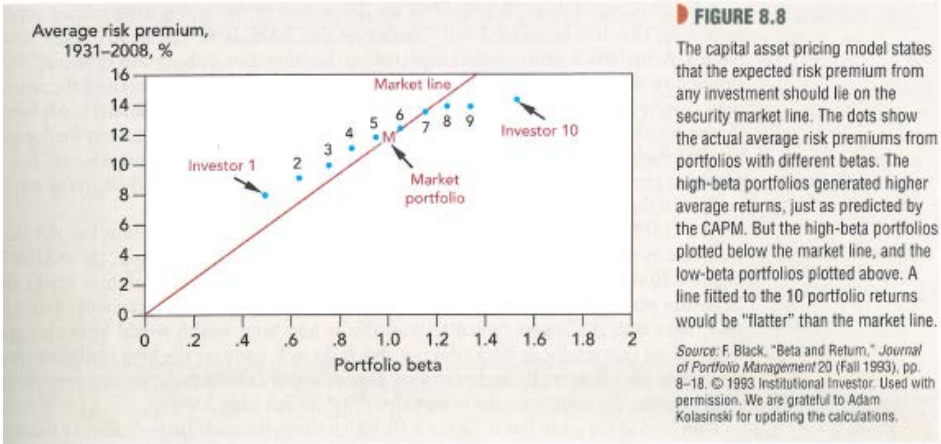


FIGURE 8.8

The capital asset pricing model states that the expected risk premium from any investment should lie on the security market line. The dots show the actual average risk premiums from portfolios with different betas. The high-beta portfolios generated higher average returns, just as predicted by the CAPM. But the high-beta portfolios plotted below the market line, and the low-beta portfolios plotted above. A line fitted to the 10 portfolio returns would be "flatter" than the market line.

Source: F. Black, "Beta and Return," *Journal of Portfolio Management* 20 (Fall 1993), pp. 8–18. © 1993 Institutional Investor. Used with permission. We are grateful to Adam Kolasinski for updating the calculations.

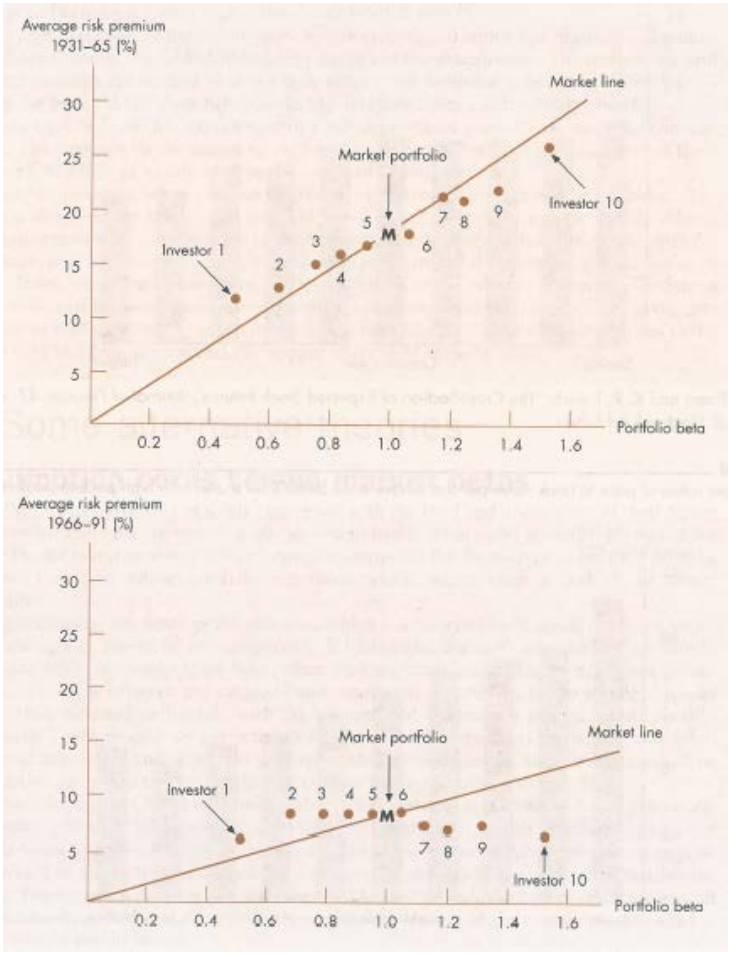
Source: Brealey, Myers, and Allen (2011), p. 197.

7.7 Partington et al (2000)[64]

164 Partington et al (2000) note that the evidence of low-beta bias has become more material in the more recent data, as summarised in Figure 8 below – the intercept has become even higher and the slope even flatter.

[64] Berk, J. and P. DeMarzo, 2014, *Corporate Finance,* 3rd global ed., Pearson.

Figure 8: The relationship between excess returns and beta



Source: Partington, G., D. Robinson, R. Brealey and S. Myers, 2000, Principles of Corporate Finance: Australian Edition, p. 211.

7.8 Berk and DeMarzo (2014)[65]

165 Another leading corporate finance textbook is Berk and DeMarzo (2014). They too consider violations of the SL-CAPM and also the explanations for those violations. They specifically note that if investors are unable to borrow unlimited amounts at the risk-free rate, the empirical relationship that has been documented in the data would be expected to occur. They also note that the result is a relationship between beta and expected returns that has a higher intercept (at r^*) and a flatter slope than the SL-CAPM would imply. They conclude that:

> Because our determination of the security market line depends only on the market portfolio being tangent for some interest rate, the SML still holds in the following form:
>
> $$E[R_i] = r^* + \beta_i\left(E[R_{Mkt}] - r^*\right)$$

[65] Berk, J. and P. DeMarzo, 2014, *Corporate Finance,* 3rd global ed., Pearson.

> That is, the SML holds with some rate r^* in place of r_f .[66]

7.9 Pratt and Grabowski (2014)[67]

166 Pratt and Grabowski (2014) is an applied valuation text that is commonly used by practitioners. Pratt and Grabowski note that concerns about the SL-CAPM have been raised by academics and practitioners:

> Despite its wide adoption, academics and practitioners alike have questioned the usefulness of CAPM in accurately estimating the cost of equity capital and the use of beta as a reliable measure of risk.[68]

167 They go on to note that one of the reasons for concern about the usefulness of the SL-CAPM is the empirical evidence of low-beta bias:

> The CAPM cost of equity estimates for high-beta stocks are too high, and estimates for low- beta stocks are too low, relative to historical returns.[69]

168 They conclude that the theoretical basis for the SL-CAPM:

> does not negate the results of empirical studies that show that beta alone is not a reliable measure of risk and realized future returns (at least not using betas drawn from realized excess returns).[70]

and they recommend the use of modified versions of the CAPM that produce estimates that are more consistent with the observed data – to correct for the empirical failings of the SL-CAPM.

7.10 Summary of the empirical evidence

169 The analysis documented above, compiled over four decades of research and using 80 years of stock returns, all reaches the same conclusion. The researchers uniformly reject the SL-CAPM on the basis that, in the observable data, the relationship between estimated betas and observed stock returns:

a. Has an intercept that is economically and statistically significantly greater than the intercept that is implied by the SL-CAPM; and

b. Has a slope that is economically and statistically significantly less than the slope that is implied by the SL-CAPM.

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[66] Berk and DeMarzo (2014), p. 399.

[67] Pratt, S. and R. Grabowski, 2014, *Cost of capital: Applications and examples,* 5th ed., Wiley.

[68] Pratt and Grabowski (2014), p. 269.

[69] Pratt and Grabowski (2014), p. 281.

[70] Pratt and Grabowski (2014), pp. 284-285.

8 Appendix 1: The Brav et al (2005) methodology for direct estimation of expected returns

8.1 Value Line data and methodology

Data source

170 Brav et al. (2005) construct estimates of expected returns using analysts' target prices. They source the majority of their data on target prices from Value Line (hereafter, VL). VL publishes weekly research reports for individual companies. It analyzes each company on a quarterly cycle such that a typical firm receives four reports per year.

171 Brav et al (2005) point out that since VL is an independent research service with no affiliation to any investment banking activity, the VL expected return is less likely to be affected by optimism bias or conflict of interest bias. Further, there are as many reports with negative recommendations as with positive, so there is no reason to suspect positive or negative bias. The VL estimates cover approximately 90% of US traded firms in terms of their market value.

Step-by-step guide to the analysis

172 The approach to estimating the relationship between beta and expected returns using the Value Line data is as follows:

- Step 1: Collect price target reports from the Value Line database for the period 1975 through 2001. This collection is restricted to firms with common shares (CRSP share codes 10 and 11)
- Step 2: Collect the market capitalization of each sample firm, calculated at the end of the prior month.
- Step 3: Collect data on the annual common shareholders' equity (Compustat item #60) for each firm.
- Step 4: Calculate the book-to-market ratio for each firm as the ratio of annual common shareholders' equity to market capitalisation at the end of the fiscal year. Apply this ratio to the 12 month period beginning six months subsequent to the end of the fiscal year
- Step 5: Calculate price momentum for each firm for each month as the buy-and-hold return for the 11 month period ending one month prior to the relevant month.
- Step 6: Construct size decile portfolios – this is based on NYSE capitalization cut-offs.

- Step 7: Construct book-to-market ratio decile portfolios. This is based on the universe of available firms on CRSP (excluding those with non-common shares).
- Step 8: Construct momentum decile portfolios. This is based on the universe of available firms on CRSP (excluding those with non-common shares).
- Step 9: Report the decile portfolio statistics for the size, book-to-market and momentum characteristics respectively for both the universe and the Value Line population.
- Step 10: Take the average of the high and low range of expected prices from each Value Line report and divide by the firm's market price outstanding prior to the Value Line report date (convert all prices to the same split-adjusted basis).
- Step 11: For the sample period prior to 1987, for each firm in the sample calculate estimates of the annual dividend yield and growth rates of dividends immediately prior to the calculation of the expected return. Calculate dividends as the sum of the dividends paid in the fiscal year before the price target is issued (Compustat data item #21). Calculate dividend growth rate as the ratio of current to prior year dividend per share (as found in Compustat data item #26), adjusted for stock splits. Calculate the dividend yield as the estimated dividend for the next year relative to the end-of-year stock price.
- Step 12: Calculate the following expression for the expected return: (assumes that dividends will continue to grow at the same historical rate, g_H, in the following four years):

$$(1 + ER_t^{VL})^4 = \frac{TP_t}{P_{t-9}} + \left(\frac{D}{P}\right)_H \cdot (1 + g_H) \cdot \left[\frac{(1+ER^{VL})^4 - (1+g_H)^4}{ER^{VL} - g_H}\right] \quad (1)$$

where $\frac{TP_t}{P_{t-9}}$ is the expected return without the dividends. Solve for the annualized expected return ER_t^{VL} that satisfies this equality.

- Step 13: For the period 1987 through 2001, obtain VL analysts' forecasts for both dividend growth rates and the next-year dividends. Use those estimates in calculating prospective dividend yield:

$$(1 + ER_t^{VL})^4 = \frac{TP_t}{P_{t-9}} + \frac{Div_{next\ year} \cdot \left[\frac{(1+ER^{VL})^4 - (1+g)^4}{ER^{VL} - g}\right]}{P_{t-9}} \quad (2)$$

where g is the VL forecasted dividend growth rate, $Div_{next\ year}$ is the VL forecast of next year dividends. Solve for the annualized expected return ER_t^{VL} as in Equation (1) above.

- Step 14: Compute expected return for each firm for each quarter.
- Step 15: Calculate time series of the sample annual expected returns based on equal weighting of individual firm forecasts.

- Step 16: Calculate time series of the sample annual expected returns based on value weighting of individual firm forecasts. For each period, value-weight all firms' expected return by their prior period market value of equity.
- Step 17: For each firm on a monthly basis, calculate firm-specific factor loadings on size and book-to-market factors using the preceding 60 months. Minimum requirement is 24 months of valid data.
- Step 18: Use the Value Line firm-specific market beta provided in each report.
- Step 19: Construct a monthly time series of one-year expected excess returns - equal to the difference between the Value Line expected return estimate and the one-year risk free rate obtained from the Fama-Bliss files on CRSP.
- Step 20: Run month-by-month regressions of the one-year excess return on the estimated factor loadings.
- Step 21: Compute the time-series average of the intercept and slope coefficients.
- Step 22: Winsorize monthly observations at the 1st and 99th percentiles to mitigate the possible effect of extreme observations. The *t*-statistics adjusted for the overlapping nature of the data are the ratio of the time-series average divided by the estimated time-series standard error.

8.2 First Call data and methodology

Data source

173 In addition to the Value Line data, Brav et al (2005) also construct an expected return measure based on the First Call database (hereafter, FC), which gathers target prices issued by sell-side analysts. They use the FC one-year-ahead target price forecasts for over 7,000 firms during the period 1997 through 2001. By using these target price forecasts, they calculate analysts' annual expected returns for each stocks. The information provided by FC is widely disseminated to all major institutional investors as well as many other investors, including individuals.

174 A key strength of the FC data is that there are forecasts from multiple analysts:

> Another advantage of this set of expectations is that a typical stock receives a target price from more than one analyst (on average, there is a target price from eight analysts per stock). As a result, the average (or the median) FC target price is likely to be less noisy and thus better reflect the consensus opinion.

175 Brav et al (2005) do note the potential concern with optimistic bias in analyst forecasts:

> On the other hand, a potential concern with sell-side analysts' expectations and recommendations is that they are biased (e.g., Rajan and Servaes, 1997, Michaely and Womack, 1999, and Barber, Lehavy, and Trueman, 2005) and that their forecasts may not accurately represent market expectations.

however, they note that this is attenuated by the fact that the same analysts are used to provide earnings forecasts and target prices. Thus any bias would be

expected to materially cancel out as it appears on both sides of the equation – in earnings forecasts and target prices.

176 Brav et al (2005) conclude that sell-side analysts' expectations are likely to be correlated with those of investors. They cite Vissing-Jorgensen (2003) who reports a similar time series pattern in individuals' expected market returns (using a UBS/Gallup monthly telephone survey of individual investors over the period 1998 through 2002).

177 The coverage of the FC data base increases over time from about 49,000 price target reports in 1997 to about 92,000 reports in 2001. The average number of price targets per covered firm also increases from 11 in 1997 to 23 in 2001. The target price database includes reports for 7,073 firms with, on average, eight brokerage houses covering each firm.

Step-by-step guide to the analysis

178 The approach to estimating the relationship between beta and expected returns using the First Call data is as follows:

- Step 1: Collect price target reports from the First Call database for the period 1997 through 2001. This collection is restricted to firms with common shares (CRSP share codes 10 and 11)
- Step 2: Collect the market capitalization of each sample firm, calculated at the end of the prior month.
- Step 3: Collect data on the annual common shareholders' equity (Compustat item #60) for each firm.
- Step 4: Calculate the book-to-market ratio for each firm as the ratio of annual common shareholders' equity to market capitalisation at the end of the fiscal year. Apply this ratio to the 12 month period beginning six months subsequent to the end of the fiscal year
- Step 5: Calculate price momentum for each firm for each month as the buy-and-hold return for the 11 month period ending one month prior to the relevant month.
- Step 6: Construct size decile portfolios – this is based on NYSE capitalization cut-offs.
- Step 7: Construct book-to-market ratio decile portfolios. This is based on the universe of available firms on CRSP (excluding those with non-common shares).
- Step 8: Construct momentum decile portfolios. This is based on the universe of available firms on CRSP (excluding those with non-common shares).
- Step 9: Report the decile portfolio statistics for the size, book-to-market and momentum characteristics respectively for both the universe and the Value Line population.

- Step 10: Exclude individual target prices outstanding for more than 30 days. In any given month over the period 1997 through 2001 calculate the ratio of each individual analyst target price to the stock price outstanding two days prior to the announcement of the individual target price (Convert all prices to the same split-adjusted basis.) For any given month, average the individual analysts' expectations to obtain the consensus expected return.
- Step 11: For the sample period prior to 1987, for each firm in the sample calculate estimates of the annual dividend yield and growth rates of dividends immediately prior to the calculation of the expected return. Calculate dividends as the sum of the dividends paid in the fiscal year before the price target is issued (Compustat data item #21). Calculate dividend growth rate as the ratio of current to prior year dividend per share (as found in Compustat data item #26), adjusted for stock splits. Calculate the dividend yield as the estimated dividend for the next year relative to the end-of-year stock price.
- Step 12: Calculate the dividend yield as the estimated dividend next year relative to the price two days prior to the issuance date of the price target. The adjustment to the expected return is then the product of the dividend yield and (one plus) the growth rate, g, of dividends:

$$1 + ER_t^{FC} = \frac{TP_t}{P_{t-2}} + \frac{Div_{current}(1+g)}{P_{t-2}} \qquad (3)$$

  where TPt /Pt-2 is the stock's consensus expected return without the dividends.
- Step 13:Compute expected return for each firm for each month.
- Step 14: Calculate time series of the sample annual expected returns based on equal weighting of individual firm forecasts.
- Step 15: Calculate time series of the sample annual expected returns based on value weighting of individual firm forecasts. For each period, value-weight all firms' expected return by their prior period market value of equity.
- Step 16: For each firm on a monthly basis, calculate firm-specific factor loadings on size and book-to-market factors using the preceding 60 months. Minimum requirement is 24 months of valid data.
- Step 17: Do the same for the market beta factor.
- Step 18: Construct a monthly time series of one-year expected excess returns, equal to the difference between the expected return estimate and the one-year risk free rate obtained from the Fama-Bliss files on CRSP.
- Step 19: Run month-by-month regressions of the one-year excess return on the estimated factor loadings.
- Step 20: Compute the time-series average of the intercept and slope coefficients.
- Step 21: Winsorize monthly observations at the 1st and 99th percentiles to mitigate the possible effect of extreme observations. The t-statistics adjusted

for the overlapping nature of the data are the ratio of the time-series average divided by the estimated time-series standard error.

8.3 Australian data and methodology

Data source

179 Since Value Line data is not available for Australia, we use the I/B/E/S analyst forecast database, which is comparable to the First Call data used by Brav et al (2005). Our sample covers the period March 2002 through to August 2017. All the data is collected via Thomson Reuters Datastream.

180 Analyst coverage increases significantly over this period, with 100 sample firms in March 2002 and 316 firms in August 2017. In total we have 1,199 firms over our 15-year sample period.

Step-by-step guide to the analysis

181 The approach to estimating the relationship between beta and expected returns using the Australian data is as follows:

- Step 1: Collect the 12-month price targets and median one-year-ahead dividend forecasts for all available firms in the IBES analyst forecast database.
- Step 2: For each firm in our sample, we collect end-of-month price and return data, adjusted for corporate events e.g. share bonuses, right offerings, stock splits and spin-off. We also collect market value for individual firms.
- Step 3: We collect the 10-year Australian Government Bond Yield to proxy for the risk free rate from Thomson Reuters.
- Step 4: We use the Total Returns Index (including dividends) to calculate the market returns.
- Step 5: Unlike Brav et al. (2005), we do not have data on the staleness of target prices, so we aren't in a position to exclude individual targe prices outstanding for more than 30 days. We also use the consensus forecast to calculate our expected returns rather than taking the average of individual expected returns. Our main tests rely primarily on the median values to alleviate the optimism bias in analyst forecasts.
- Step 6: Instead of estimating a dividend growth rate using current and prior period dividends, we use the one-year ahead dividend forecast directly, because we wish to utilize market expectations as closely as possible. Again, our main tests utilize median values to reduce the potential optimism bias.
- Step 7: This allows us to estimate the one-year expected return by solving for the following:

$$1 + ER_t = \frac{TP_t + E_t(D_{t+1})}{P_t} \qquad (4)$$

where ER_t is the expected return over the next 12 months, TP_t is the one-year target price, $E_t(D_{t+1})$ is the one-year ahead dividend forecast and P_t is the current share price.

- Step 8: Compute expected return for each firm for each month. To prevent the effect of outliers, we remove from our sample observations with an estimated cost of capital of greater 20% or less than 0%. Similarly. we restrict our analysis to the largest 100 firms by market capitalisation.
- Step 9: We use the market model to estimate individual firm beta for each month as below:

$$R_{i,t} = \alpha_i + \beta R_{m,t} + \varepsilon_{i,t} \quad (5)$$

where $R_{i,t}$ is the firm realised returns at time *t*, α_i is the intercept of the regression, β is the coefficient estimate, and $R_{m,t}$ is the market return at time *t*. In month t, we run the a time series regression using 60-month data preceding that month to obtain the beta estimate i.e. We also require a minimum of 24 valid monthly returns.

- Step 10: After obtaining the expected return and beta estimates for each firm-month, we perform the individual Capital Asset Pricing Test (Individual CAPM) using the Fama-MacBeth (1973) method. Specifically, for each month, we run a cross-sectional regression of the ex-ante expected returns excess returns on the beta estimates:

$$ER_i - R_f = \alpha + \beta_i \gamma + \epsilon_i \quad (6)$$

where ER_i is the firm ex-ante expected returns, α_t is the intercept of the regression, γ is the coefficient estimate, and β_i is the firm i's systematic risk estimated from equation (2).

- Step 11: Calculate the time series averages of the cross-sectional regressions estimates α and γ. To judge the statistical significance of the estimates, we use the Newey-West (1987) t-statistics corrected for auto-correlation.
- If the CAPM fails to explain expected returns, we would expect the mispricing error i.e. intercept α is statistically different from 0. The coefficient γ can be interpreted as the market risk premium.
- Step 12: We test the CAPM on the portfolio level. We form ranked-beta decile portfolios. In particular, in December each year, we allocate firms into deciles based on their historical betas. For example, Decile 1 contains firms with the 10% lowest betas, while the top 10% highest beta firms are in Decile 10. We then calculate the portfolios' equal-weighted returns for the next 12 months. We reform the portfolios annually in December.
- Step 13: With the sample of portfolio returns, we estimate portfolio betas using equation (2). We use 24-month rolling regression to estimate the portfolio betas.
- Step 14: We repeat the CAPM test as in (3) on the portfolio level. We again use Newey-West (1987) *t*-statistic to correct for the autocorrelation.

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APPENDIX C:

HoustonKemp, *The relation between the equity and debt risk premiums*, September 2018

HOUSTONKEMP
Economists

The relation between the equity and debt risk premiums

A Report for the APGA

September 2018

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Disclaimer

Contents

Figures

Tables

Executive summary

The Australian Energy Regulator (AER) released its draft rate of return guideline on 10 July 2018. In the guideline, the AER observes that the value that it uses for the equity risk premium, the gap between the return it offers to equity holders and the risk-free rate, is now 170 basis points above its value for the debt risk premium, the gap between the promised return on debt and the risk-free rate, whereas in 2013 the gap between the values it chose for the two risk premiums was only 115 basis points. In light of this observation the AER states that: [1]

> This gives us confidence that service providers, relative to the margin at the start of the 2013 Guideline, have a reasonable opportunity to recover at least their efficient costs of equity over the life of the 2018 Guideline.

The APGA has asked HoustonKemp to assess, as a theoretical matter, what relation should exist between the equity risk premium and the debt risk premium. In particular, the APGA has asked:

- whether, as a theoretical matter, the equity risk premium and the debt risk premium should move together in lockstep so that the gap between the two risk premiums should remain constant; and
- whether, as a theoretical matter, the equity risk premium and the debt risk premium should even necessarily move together.

A natural framework to use in answering these questions is the framework of Merton (1974). [2] Merton observes that the equity of a firm that has a single issue of pure discount bonds outstanding can be viewed as a call option written on the value of the firm with an exercise price equal to the face value of the debt. Merton uses the Black-Scholes (1973) option pricing framework to determine the value of a firm's equity, the value of its debt and the yield on its debt. [3] Merton's model can also be used together with Sharpe-Lintner CAPM to determine the returns required on the equity and debt of the firm. We use Merton's framework to examine the relation between the equity risk premium and the debt risk premium.

In particular, we use numerical examples to examine the impact on the difference between the equity risk premium and the debt risk premium of:

- changes in the value of the firm; and
- changes in the standard deviation of the return to the firm.

Using these numerical examples, we show that:

- as a theoretical matter, the equity risk premium and the debt risk premium need not move together in lockstep so that the gap between the two risk premiums need not remain constant; and
- as a theoretical matter, the equity risk premium and the debt risk premium need not even necessarily move together.

It is, of course, true that Merton's model does not rule out conditions under which the spread between the equity and debt risk premiums and the debt risk premium move together. So whether the two quantities move together is essentially an empirical question. As a purely theoretical matter, however, a widening of the spread between the equity risk premium and the debt risk premium as the debt risk premium falls need not signify that the equity risk premium has been set incorrectly.

[1] AER, *Draft rate of return guidelines: Explanatory statement*, July 2018, page 54.

[2] Merton, R.C., *On the pricing of corporate debt: The risk structure of interest rates,* 1974, pages 449-470.

[3] Black, F. and M. Scholes, The pricing of options and corporate liabilities, Journal of Political Economy, 1973, pages 637-654.

1. Introduction

The Australian Energy Regulator (AER) released its draft rate of return guideline on 10 July 2018. In the guideline, the AER observes that the value that it uses for the equity risk premium, the gap between the return it offers to equity holders and the risk-free rate, is now 170 basis points above its value for the debt risk premium, the gap between the promised return on debt and the risk-free rate, whereas in 2013 the gap between the values it chose for the two risk premiums was only 115 basis points. In light of this observation the AER states that: [4]

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The rest of the report is organised as follows:

- section 2 describes the framework that Merton uses to price corporate debt;
- section 3 provides examples that show that the equity risk premium and debt risk premium need not move together in lockstep nor even indeed together.

In addition:

- Appendix A1 provides the terms of reference for this report; and
- Appendix A2 provides the curriculum vitae of the author of the report.

[4] AER, *Draft rate of return guidelines: Explanatory statement*, July 2018, page 54.

[5] Merton, R.C., *On the pricing of corporate debt: The risk structure of interest rates,* 1974, pages 449-470.

[6] Black, F. and M. Scholes, The pricing of options and corporate liabilities, Journal of Political Economy, 1973, pages 637-654.

Statement of credentials

This report has been prepared by **Simon Wheatley**.

Simon Wheatley is a Special Adviser to HoustonKemp and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his finance expertise in consulting and investment management outside the university sector. Simon's interests and expertise are in how assets are priced. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington.

2. Theory

In an important contribution to the finance literature, Merton (1974) shows how one can use the Black-Scholes (1973) option pricing framework to determine the value of a firm's equity, the value of its debt and the yield on its debt when a firm has only a single issue of pure discount bonds outstanding.[7] A pure discount bond is a bond that pays no coupons.

Merton recognises that the equity of a firm with a single issue of pure discount bonds outstanding can be viewed as a call option written on the value of the firm with the exercise price of the call equal to the face value of the debt. The debt of the firm can be viewed as a combination of a pure discount government bond and a short position in a put written on the value of the firm with an exercise price also equal to the face value of the debt.

Black and Scholes show that a hedge can be produced by combining, appropriately, call options written on a share of stock and shares of the stock on which the shares are written. Since the hedge is risk-free, it must deliver the risk-free rate of return. From this condition, which must hold to avoid arbitrage opportunities, the price of the call can be determined.

2.1 Assumptions

Merton makes the following assumptions:

1. there are no taxes, no transaction costs and assets are infinitely divisible;
2. each investor is a price-taker;
3. investors can borrow or lend at a risk-free rate;
4. there are no short-sale restrictions;
5. trading takes place continuously through time;
6. the Modigliani-Miller capital structure irrelevance proposition holds;
7. the risk-free rate is constant through time; and
8. the value of the firm follows a diffusion process.

The Modigliani-Miller capital structure irrelevance proposition states that under certain assumptions the value of a firm will not depend on its capital structure. A diffusion process is a Markov process that has continuous sample paths, and can be defined by specifying its first two moments.

2.2 Values

Under assumptions 1 through 8, Merton shows that the value of equity will be given:

$$E = V\mathrm{N}(d_1) - \mathrm{e}^{-rt}\, X\mathrm{N}(d_2), \quad d_1 = \frac{\log(V / X) + (r + \sigma^2 / 2)t}{\sigma\sqrt{t}}, \quad d_2 = d_1 - \sigma\sqrt{t} \qquad (1)$$

where:

V = the value of the firm;

[7] Black, F. and M. Scholes, The pricing of options and corporate liabilities, Journal of Political Economy, 1973, pages 637-654.
Merton, R.C., *On the pricing of corporate debt: The risk structure of interest rates,* 1974, pages 449-470.

r	=	the risk-free rate per annum;
t	=	the time to maturity in years;
X	=	the face value of the debt;
σ	=	the standard deviation of the return to the firm per annum; and
$\mathrm{N}(x)$	=	the probability that a number drawn at random from a standard normal distribution will fall below x.

The value of debt, on the other hand, will be given by:

$$D = V - E = V(1 - \mathrm{N}(d_1)) + \mathrm{e}^{-rt} X\mathrm{N}(d_2), \quad (2)$$

One can show that the value of equity will be, all else constant:

- positively related to the value of the firm;
- positively related to the risk-free rate;
- positively related to the time to maturity;
- negatively related to the face value of the debt; and
- positively related to the standard deviation of the return to the firm.

Similarly, one can show that the value of debt will be, all else constant:

- positively related to the value of the firm;
- negatively related to the risk-free rate;
- negatively related to the time to maturity;
- positively related to the face value of the debt; and
- negatively related to the standard deviation of the return to the firm.

These relations are summarised in Table 1 below and the intuition for them is as follows.

An increase in the value of the firm, all else constant, will raise the probability that the debt will be repaid and will raise the probability that equity, as a residual claimant, will be rewarded. So an increase in the value of the firm, all else constant, will raise the value of equity and raise the value of debt.

An increase in the risk-free rate, all else constant, will lower the present value of the face value of the debt. So an increase in the risk-free rate, all else constant, will lower the value of the debt and raise the value of equity.

An increase in the time to maturity, all else constant, will lower the present value of the face value of the debt. It will also raise the variability of the value of the firm at the maturity of the debt. Both of these factors will contribute to a decline in the value of the debt and so to an increase in the value of equity.

An increase in the face value of the debt, all else constant, will raise the present value of the face value of the debt. So an increase in the face value of the debt, all else constant, will raise the value of the debt and lower the value of equity.

Equity holds a call option on the value of the firm. Since the holder of a call has the right but not the obligation to exercise, the holder will not care about downside risk but will value upside risk. It follows that an

increase in the standard deviation of the return to the firm will, all else constant, raise the value of equity and so lower the value of the debt.

Table 1: Factors determining the values of equity and debt

	Relation, all else constant, between factor and	
Factor	value of equity	value of debt
Value of the firm	+ ve	+ ve
Risk-free rate	+ ve	– ve
Time to maturity	+ ve	– ve
Face value of the debt	– ve	+ ve
Standard deviation of the return to the firm	+ ve	– ve

2.3 Yields

The yield on the firm's debt, that is, the promised return on debt, will be given by

$$y = (X / D)^{1/t} - 1 \qquad (3)$$

Since the yield is inversely related to the value of debt, one can infer from the relations already described what impact changes in the value of the firm, the risk-free rate, the time to maturity and the standard deviation of the return to the firm will have on the yield, all else constant.

2.4 Betas

Using a result from the work of Black and Scholes, one can also show that the equity and debt betas of the firm will be given by:

$$\beta_E = \frac{\partial E}{\partial V}\frac{V}{E}\beta_V \quad \text{and} \quad \beta_D = \frac{\partial D}{\partial V}\frac{V}{D}\beta_V, \quad \text{where} \quad \frac{\partial E}{\partial V} = \mathrm{N}(d_1), \quad \frac{\partial D}{\partial V} = 1 - \mathrm{N}(d_1), \qquad (4)$$

and where:

β_E	=	the equity beta of the firm;
β_V	=	the beta of the firm; and
β_D	=	the debt beta of the firm.

One can show that, consistent with intuition:

$$\beta_E > \beta_V \quad \text{and} \quad \beta_D < \beta_V \qquad (5)$$

2.5 Equity and debt risk premiums

Merton's model allows plenty of scope for the equity and debt risk premiums to move in various ways in response to changes in the value of the firm, the risk-free rate, the time to maturity, the face value of debt and the standard deviation of the return to the firm. Rather than provide an algebraic response to the questions posed by the APGA, we provide in the next section simple numerical examples to show that:

- as a theoretical matter, the equity risk premium and the debt risk premium need not move together in lockstep so that the gap between the two risk premiums need not remain constant; and
- as a theoretical matter, the equity risk premium and the debt risk premium need not even necessarily move together.

Thus, as a purely theoretical matter, a widening of the spread between the equity risk premium and the debt risk premium as the debt risk premium falls need not signify that the equity risk premium has been set incorrectly.

3. Examples

We examine the impact on the difference between the equity risk premium, the gap between the return required on equity and the risk-free rate, and the debt risk premium, the gap between the promised return on debt and the risk-free rate, of:

- changes in the value of the firm; and
- changes in the standard deviation of the return to the firm.

In both examples we assume that:

$$r = 0.025, \quad t = 10, \quad X = 60, \quad \beta_V = 0.30 \tag{6}$$

We also assume that the market risk premium is, hypothetically, six per cent per annum. We choose these values because the yield on a 10-year Commonwealth Government Security currently sits not far from 2.5 per cent per annum, regulated energy utilities typically issue debt with a maturity of 10 years, the asset beta of a regulated energy utility sits not far from 0.3 and the market risk premium sits not far from six per cent per annum. By not far we mean, for example, that the asset beta sits closer to 0.3 than to 0.6 and the market risk premium sits closer to six per cent per annum than to 12 per cent per annum. We emphasise that the values that we choose for the model's parameters are hypothetical and should not be viewed as estimates of the parameters.

3.1 Changes in the value of the firm

To examine the impact of changes in the value of the firm on the equity and debt risk premiums, we also assume that:

$$\sigma = 0.20 \tag{7}$$

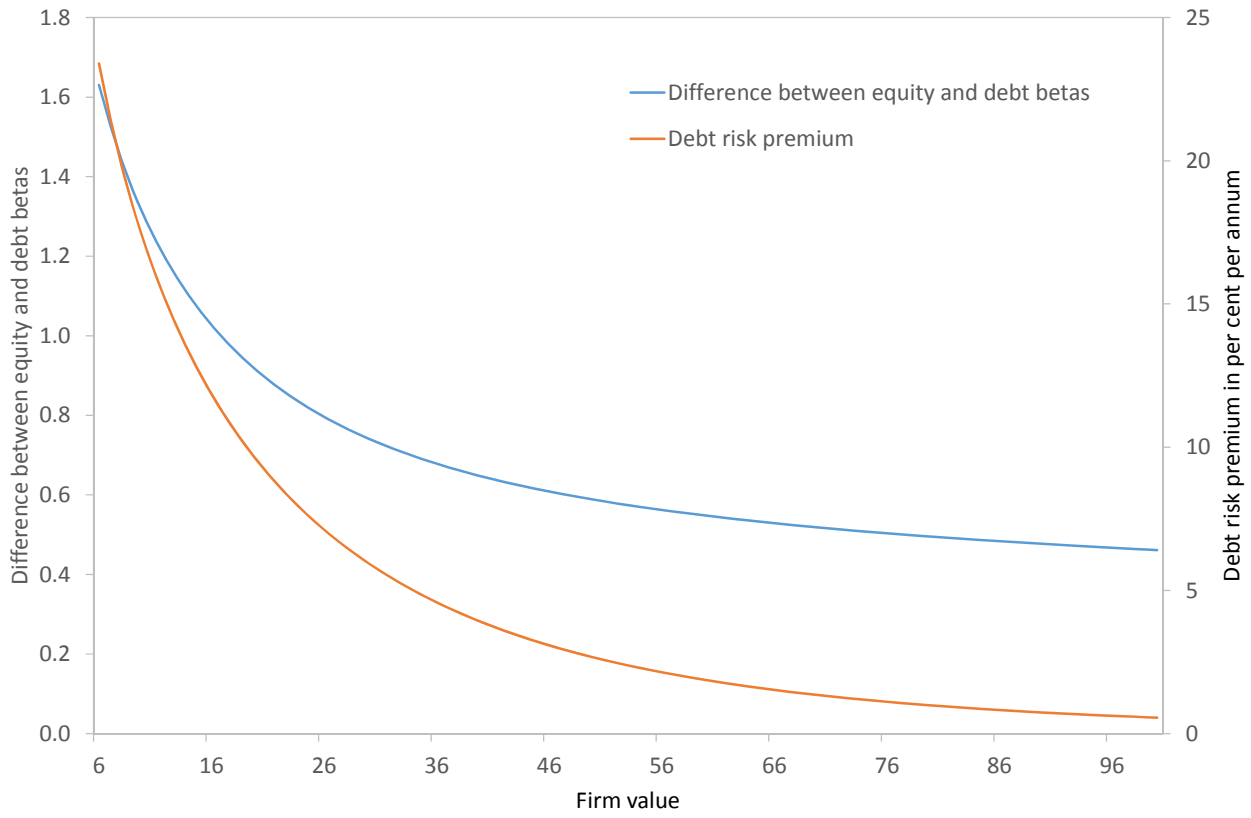
We examine first what impact changes in the value of the firm will have on the difference between the equity and debt betas. If the SL CAPM is true, the difference between the equity and debt betas will determine the difference between the required returns on equity and debt. The comparison that the AER makes is not between the required returns on equity and debt but between the required return on equity and the promised return on debt. [8] It is nevertheless interesting to examine how the difference between the equity and debt betas – and so the difference between the required returns to equity and debt – will respond, all else constant, with the assumptions that we make, to changes in the value of the firm.

Figure 1 below shows that, with the assumptions that we make, the yield on debt and the spread between the equity and debt betas will fall as the value of the firm rises. Both the equity beta and the debt beta will fall as the value of the firm rises and the firm becomes less levered, but the equity beta will fall faster than the debt beta. Thus the difference between the required returns on equity and debt will fall as the debt yield falls.

Figure 2 shows, however, that the difference between the equity risk premium, the gap between the return required on equity and the risk-free rate, and the debt risk premium, the gap between the promised return on debt and the risk-free rate, will rise as the value of the firm rises.

[8] The difference between the equity risk premium and the debt risk premium is merely the difference between the required return on equity and the promised return on debt, that is, the yield on debt.

Figure 1: The impact on equity and debt betas of changes in the value of the firm



The intuition behind these two seemingly conflicting results is that the debt yield will fall faster than the required return on debt as the value of the firm rises because the probability that the firm will default on its debt will fall and the yield on debt is more sensitive to the probability of default than the required return on debt.

In Figure 2 the equity risk premium and the debt risk premium move together but the debt risk premium falls faster than the equity risk premium and so the spread between the equity and debt risk premiums rises as the debt risk premium falls.

Thus Figure 2 shows that:

- the spread between the equity and debt risk premiums can rise as the debt risk premium falls.

In the next example that we consider, the equity risk premium and the debt risk premium will move in opposite directions.

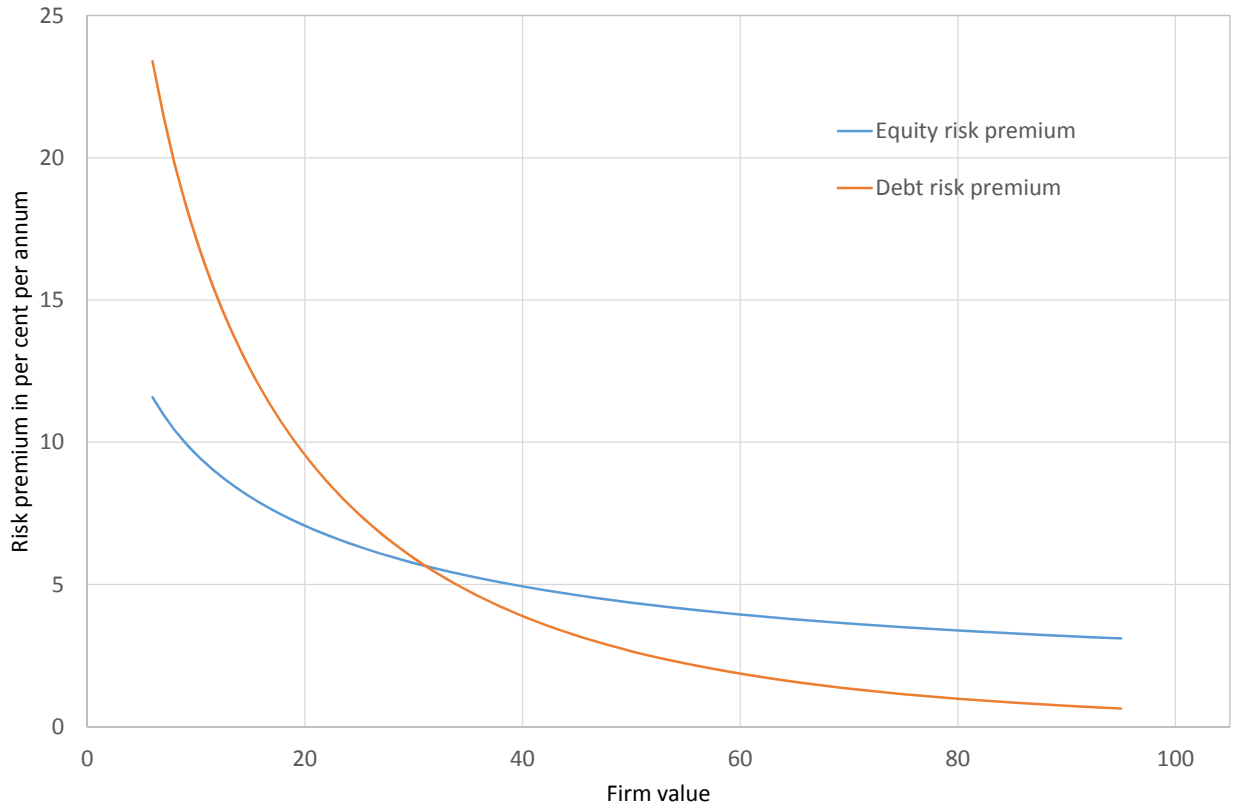
3.2 Changes in the standard deviation of the return to the firm

To examine the impact of changes in the standard deviation of the return to the firm on the equity and debt risk premiums, we assume that:

$$V = 80 \qquad (8)$$

Since the face value of the debt is 60, this assumption implies that there will be a significant probability that the firm will default when the standard deviation of the return to the firm is high.

Figure 2: The impact on equity and debt risk premiums of changes in the value of the firm



We first examine first what impact changes in the standard deviation of the return to the firm will have on the difference between the equity and debt betas. Figure 3 below shows that with the assumptions that we make, the yield on debt will rise as the standard deviation of the return to the firm rises but the spread between equity and debt betas will fall as the standard deviation rises. The debt yield will rise because the probability of default will rise. The equity beta will fall as the standard deviation rises because as the standard deviation of the return to the firm rises the value of debt will fall and the firm will become less levered. On the other hand, the debt beta will rise as the standard deviation of the return to the firm rises because the sensitivity of the value of debt to changes in the value of the firm will rise.

Figure 3 shows, therefore, that the difference between the required returns on equity and debt will rise as the debt yield falls.

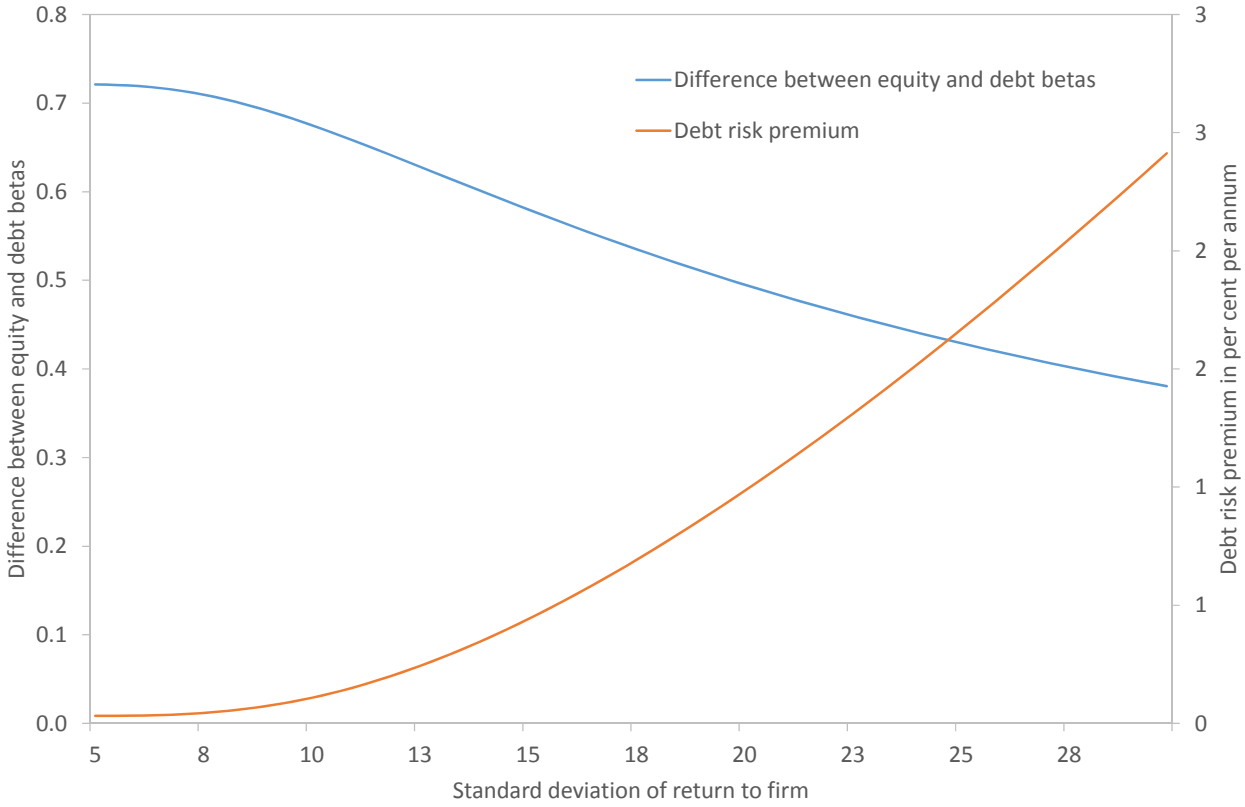
Figure 4 shows that the debt yield will rise and the difference between the equity risk premium and the debt risk premium will fall as the standard deviation of the return to the firm rises. The yield on debt will rise as the standard deviation of the return to the firm rises because the probability of default will rise. The equity risk premium will fall as the standard deviation rises because as the standard deviation of the return to the firm rises the equity beta will fall. Again, the equity beta will fall, as the standard deviation of the return to the firm rises, because the value of equity will rise and the value of debt will fall so that the firm will become less levered. [9]

[9] Recall that equity holds a call option on the value of the firm. Since the holder of a call has the right but not the obligation to exercise, the holder will not care about downside risk but will value upside risk. It follows that an increase in the standard deviation of the return to the firm will, all else constant, raise the value of equity and lower the value of the debt.

Figure 4 shows that:

- as a theoretical matter, the equity risk premium and the debt risk premium need not move together.

Figure 3: The impact on equity and debt betas of changes in the standard deviation of the return to the firm



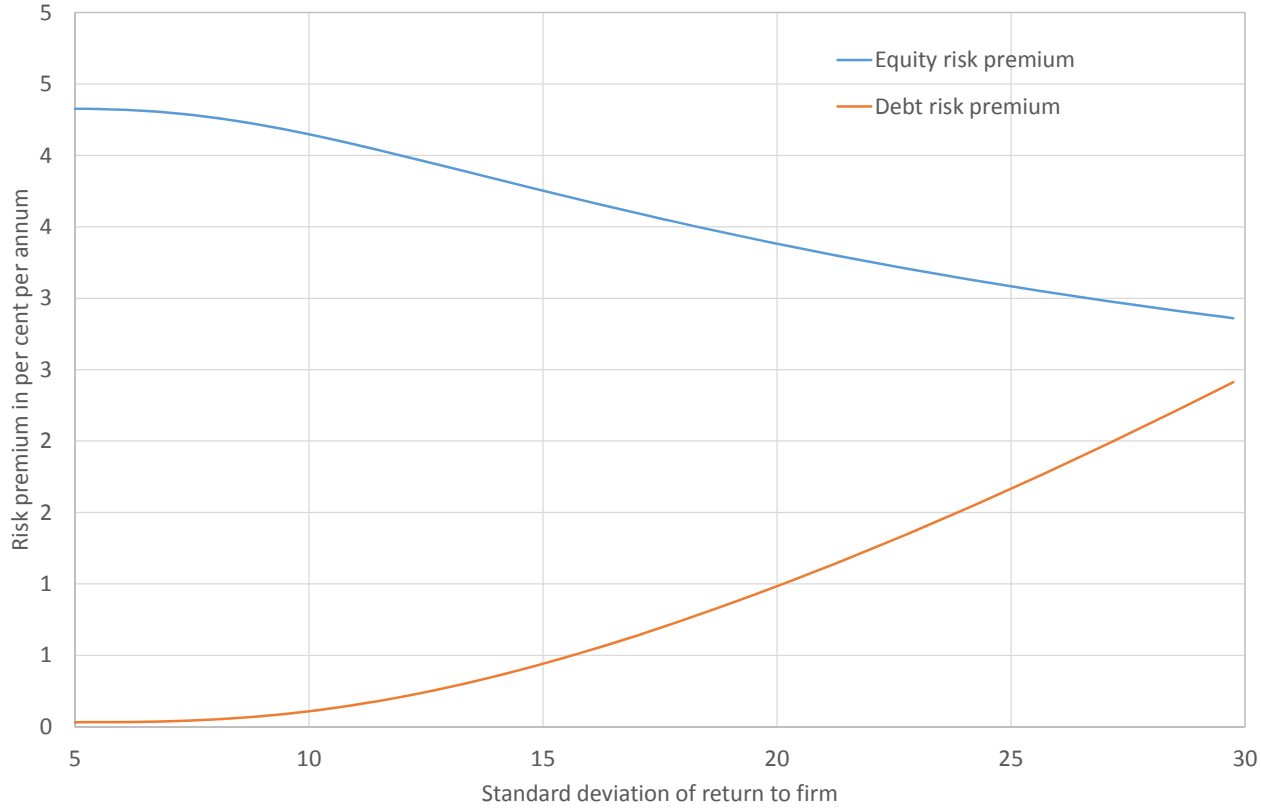
3.3 Discussion

We show that:

- as a theoretical matter, the equity risk premium and the debt risk premium need not move together in lockstep so that the gap between the two risk premiums need not remain constant; and
- as a theoretical matter, the equity risk premium and the debt risk premium need not even necessarily move together.

It is, of course, true that Merton's model does not rule out conditions under which the spread between the equity and debt risk premiums and the debt risk premium move together. So whether the two quantities move together is essentially an empirical question. As a purely theoretical matter, however, a widening of the spread between the equity risk premium and the debt risk premium as the debt risk premium falls need not signify that the equity risk premium has been set incorrectly.

Figure 4: The impact on equity and debt risk premiums of changes in the standard deviation of the return to the firm



A1. Terms of reference

Expert terms of reference

APGA debt risk premium brief

2018-23 AER rate of return guidelines September 2018

In the draft guidelines, the AER uses as its dominant cross check a comparison between the debt and equity risk premiums and observes that the difference between the two is wider now than it was at the time of the last guidelines (December 2013). In light of this observation the AER states that: [10]

> This gives us confidence that service providers, relative to the margin at the start of the 2013 Guideline, have a reasonable opportunity to recover at least their efficient costs of equity over the life of the 2018 Guideline.

Please examine the basis for this comparison between these two variables, in particular focussing upon:

- whether, as a theoretical matter, the equity risk premium and the debt risk premium should move together in lockstep so that the gap between the two risk premiums should remain constant; and
- whether, as a theoretical matter, the equity risk premium and the debt risk premium should even necessarily move together.

[10] AER, *Draft rate of return guidelines: Explanatory statement*, July 2018, page 54.

A2. Curriculum vitae

Simon M. Wheatley

Tel: [redacted]
E-mail: [redacted]

Overview

Simon is a special adviser to HoustonKemp and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his expertise outside the university sector to solving problems in consulting and in fund management. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington. Simon's interests and expertise are in how assets are priced.

Employment

- Special Adviser, HoustonKemp, 2015-
- Affiliated Industry Expert, NERA Economic Consulting, 2014-2015
- Special Consultant, NERA Economic Consulting, 2009-2014
- External Consultant, NERA Economic Consulting, 2008-2009
- Quantitative Analyst, Victorian Funds Management Corporation, 2008-2009
- Adjunct, Melbourne Business School, 2008
- Professor, Department of Finance, University of Melbourne, 2001-2008
- Associate Professor, Department of Finance, University of Melbourne, 1999-2001
- Associate Professor, Australian Graduate School of Management, 1994-1999
- Visiting Assistant Professor, Graduate School of Business, University of Chicago, 1993-1994
- Visiting Assistant Professor, Faculty of Commerce, University of British Columbia, 1986
- Assistant Professor, Graduate School of Business, University of Washington, 1984-1993

Education

- Ph.D., University of Rochester, USA, 1986; Major area: Finance; Minor area: Applied statistics; Thesis topic: Some tests of international equity market integration; Dissertation committee: Charles I. Plosser (chairman), Peter Garber, Clifford W. Smith, Rene M. Stulz
- M.A., Economics, Simon Fraser University, Canada, 1979
- M.A., Economics, Aberdeen University, Scotland, 1977

Publicly Available Reports

HoustonKemp

- A Constructive Review of the ERA's Approach to the MRP: A report for Western Power, June 2017 (with Brendan Quach)
- The Cost of Equity and the Low-Beta Bias: A report for Multinet, November 2016
- Evaluating Forecasts: Response to the ERA's Draft Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline 2016 – 2020: A report for DBP, February 2016
- The Black CAPM: Response to the ERA's Draft Decision on Proposed Revisions to the Access Arrangement for the Dampier to Bunbury Natural Gas Pipeline 2016 – 2020: A report for DBP, February 2016
- The Cost of Equity: Response to the AER's Draft Decisions for the Victorian Electricity Distributors, ActewAGL Distribution and Australian Gas Networks: A report for ActewAGL Distribution, AusNet Services, Australian Gas Networks, CitiPower, Jemena Electricity Networks, Powercor and United Energy, January 2016
- Equity Beta for a Benchmark Australian Water Network Service Provider: A report for Sydney Water, June 2015 (with Greg Houston, Brendan Quach and Dale Yeats)

NERA

- Estimating Distribution and Redemption Rates: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors, and for Jemena Gas Networks: A report for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy, June 2015
- Further Assessment of the Historical MRP: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors: A report for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Energex, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy, June 2015
- The Cost of Equity: Response to the AER's Final Decisions for the NSW and ACT Electricity Distributors, and for Jemena Gas Networks: A report for ActewAGL Distribution, AGN, APA, AusNet Services, CitiPower, Ergon Energy, Jemena Electricity Networks, Powercor, SA Power Networks and United Energy, June 2015
- The Cost of Equity: A Critical Review of the Analysis of the AER and its Advisors: A report for DBP, June 2015
- Do Imputation Credits Lower the Cost of Equity? Cross-Sectional Tests: A report for United Energy, April 2015
- The Relation Between the Market Risk Premium and Risk-Free Rate: Evidence from Independent Expert Reports: A report for United Energy, April 2015
- Review of the Literature in Support of the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French Three-Factor Model A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA PowerNetworks, and United Energy, March 2015
- Estimating Distribution and Redemption Rates from Taxation Statistics A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Ergon Energy, Powercor, SA PowerNetworks and United Energy, March 2015
- Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy, February 2015

- Historical estimates of the market risk premium: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausgrid, AusNet Services, Australian Gas Networks, CitiPower, Endeavour Energy, Energex, Ergon, Essential Energy, Powercor, SA Power Networks and United Energy, February 2015
- Robust regression techniques: A report for DBP, December 2014
- Imputation Credits and Equity Returns: A report for the Energy Networks Association, October 2013 (with Brendan Quach)
- The Fama-French Three-Factor Model: A report for the Energy Networks Association, October 2013 (with Brendan Quach)
- The Market Risk Premium: Analysis in Response to the AER's Draft Rate of Return Guidelines: A report for the Energy Networks Association, October 2013 (with Brendan Quach)
- The Market, Size and Value Premiums: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- Estimates of the Zero-Beta Premium: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- The Payout Ratio: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- Review of Cost of Equity Models: A report for the Energy Networks Association, June 2013 (with Brendan Quach)
- The Cost of Equity for a Regulated Energy Utility: A Response to the QCA Discussion Paper on the Risk-Free Rate and the MRP: A report for United Energy and Multinet Gas, March 2013 (with Brendan Quach)
- The Cost of Equity for a Regulated Energy Utility: A report for Multinet, February 2013 (with Brendan Quach)
- The Black CAPM: A report for APA Group, Envestra, Multinet & SP AusNet, March 2012 (with Brendan Quach)
- Prevailing Conditions and the Market Risk Premium: A report for APA Group, Envestra, Multinet & SP AusNet, March 2012 (with Brendan Quach)
- The Market Risk Premium: A report for CitiPower, Jemena, Powercor, SP AusNet and United Energy, 20 February 2012 (with Brendan Quach)
- Cost of Equity in the ERA DBNGP Draft Decision: A report for DBNGP, 17 May 2011 (with Brendan Quach)
- The Market Risk Premium: A report for Multinet Gas and SP AusNet, 29 April 2011 (with Brendan Quach)
- Cost of Capital for Water Infrastructure Company Report for the Queensland Competition Authority, 28 March 2011 (with Brendan Quach)
- The Cost of Equity: A report for Orion, 2 September 2010 (with Greg Houston and Brendan Quach)
- New Gamma Issues Raised by AER Expert Consultants: A report for JGN, 17 May 2010 (with Brendan Quach)
- The Required Rate of Return on Equity for a Gas Transmission Pipeline: A Report for DBP, 31 March 2010 (with Brendan Quach)
- Jemena Access Arrangement Proposal for the NSW Gas Networks: AER Draft Decision: A report for Jemena, 19 March 2010 (with Greg Houston and Brendan Quach)
- Payout Ratio of Regulated Firms: A report for Gilbert + Tobin, 5 January 2010 (with Brendan Quach)

- Review of Da, Guo and Jagannathan Empirical Evidence on the CAPM: A report for Jemena Gas Networks, 21 December 2009 (with Greg Houston and Brendan Quach)
- The Value of Imputation Credits for a Regulated Gas Distribution Business: A report for WA Gas Networks, 18 August 2009 (with Greg Houston, Brendan Quach and Tara D'Souza)
- Cost of Equity - Fama-French Three-Factor Model Jemena Gas Networks (NSW), 12 August 2009 (with Jeff Balchin, Greg Houston and Brendan Quach)
- Estimates of the Cost of Equity: A report for WAGN, 22 April 2009 (with Brendan Quach)
- AER's Proposed WACC Statement – Gamma: A report for the Joint Industry Associations, 30 January 2009 (with Greg Houston and Brendan Quach)
- The Value of Imputation Credits: A report for the ENA, Grid Australia and APIA, 11 September 2008 (with Greg Houston and Brendan Quach)

Consulting Experience

- HoustonKemp, 2015 -
- NERA, 2008 - 2015
- Lumina Foundation, Indianapolis, 2009
- Industry Funds Management, 2010

Academic Publications

- Imputation credits and equity returns, (with Paul Lajbcygier), 2012, *Economic Record* 88, 476-494.
- Do measures of investor sentiment predict returns? (with Robert Neal), 1998, *Journal of Financial and Quantitative Analysis* 33, 523-547.
- Adverse selection and bid-ask spreads: Evidence from closed-end funds (with Robert Neal), 1998, *Journal of Financial Markets* 1, 121-149.
- Shifts in the interest-rate response to money announcements: What can we say about when they occur? (with V. Vance Roley), 1996, *Journal of Business and Economic Statistics* 14, 135-138.
- International investment restrictions and closed-end country fund prices, (with Catherine Bonser-Neal, Greggory Brauer, and Robert Neal), 1990, *Journal of Finance* 45, 523-547 (reprinted in International Capital Markets Volume III, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).
- A critique of latent variable tests of asset pricing models, 1989, *Journal of Financial Economics* 21, 177-212.
- Some tests of international equity market integration, 1988, *Journal of Financial Economics* 21, 177-212 (reprinted in International Capital Markets Volume I, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).
- Some tests of the consumption-based asset pricing model, 1988, *Journal of Monetary Economics* 22, 193-215.

Working Papers

- An evaluation of some alternative models for pricing Australian stocks (with Paul Lajbcygier), 2009.
- Intertemporal substitution, small-sample bias, and the behaviour of U.S. household consumption (with Kogulakrishnan Maheswaran and Robert Porter), 2007.
- Keeping up with the Joneses, human capital, and the home-equity bias (with En Te Chen), 2003.
- Evaluating asset pricing models, 1998.
- Time-non-separable preferences or artifact of temporal aggregation? (with Robert Porter), 2002.
- Testing asset pricing models with infrequently measured factors, 1989.

Refereeing Experience

- Referee for Accounting and Finance, the Australian Journal of Management, Economic Letters, Financial Analysts Journal, Financial Management, Journal of Accounting and Economics, Journal of Business, Journal of Empirical Finance, Journal of Finance, Journal of Financial and Quantitative Analysis, Journal of Financial Economics, Journal of Futures Markets, Journal of International Economics, Journal of International Money and Finance, Journal of Money, Credit, and Banking, Journal of Monetary Economics, Management Science, National Science Foundation, Pacific-Basin Finance Journal, and the Review of Financial Studies.
- Program Committee for the Western Finance Association in 1989 and 2000.

Teaching Experience

- International Finance, Melbourne Business School, 2008
- Corporate Finance, International Finance, Investments, University of Melbourne, 1999-2008
- Corporate Finance, International Finance, Investments, Australian Graduate School of Management, 1994-1999
- Investments, University of Chicago, 1993-1994
- Investments, University of British Columbia, 1986
- International Finance, Investments, University of Washington, 1984-1993
- Investments, Macroeconomics, Statistics, University of Rochester, 1982
- Accounting, 1981, Australian Graduate School of Management, 1981

Teaching Awards

- MBA Professor of the Quarter, Summer 1991, University of Washington

Computing Skills

- User of SAS since 1980. EViews, Excel, LaTex, Matlab, R, Visual Basic. Familiar with the SIRCA SPPR, Compustat and CRSP databases. Some familiarity with Bloomberg, FactSet and IRESS.

Board Membership

- Anglican Funds Committee, Melbourne, 2008-2011

Honours

- Elected a member of Beta Gamma Sigma, June 1986.

Fellowships

- Earhart Foundation Award, 1982-1983
- University of Rochester Fellowship, 1979-1984
- Simon Fraser University Fellowship, 1979
- Inner London Education Authority Award, 1973-1977

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