Low-beta bias and the Black CAPM

REPORT PREPARED FOR AUSTRALIAN GAS INFRASTRUCTURE GROUP AND APA GROUP

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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 <u>expected</u> 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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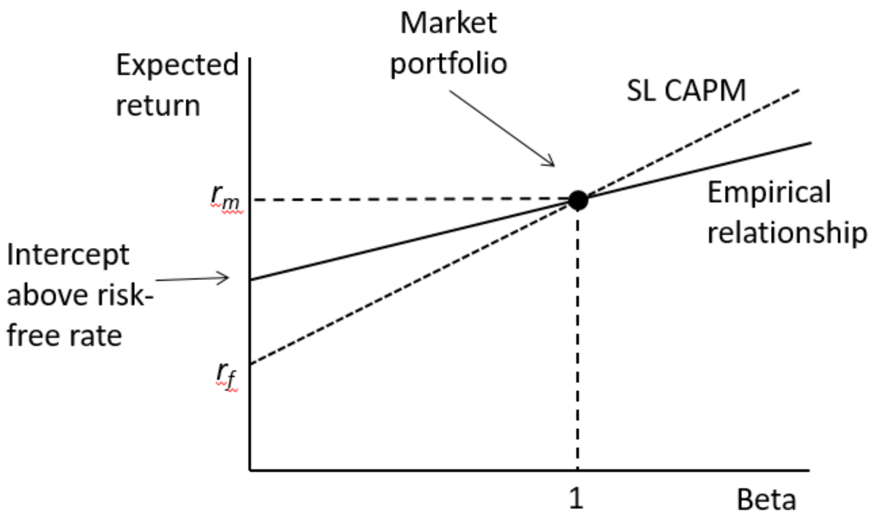
[2] AER, July 2018, Draft Rate of Return Guideline, Explanatory Statement, p. 277.

[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.

[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.

[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

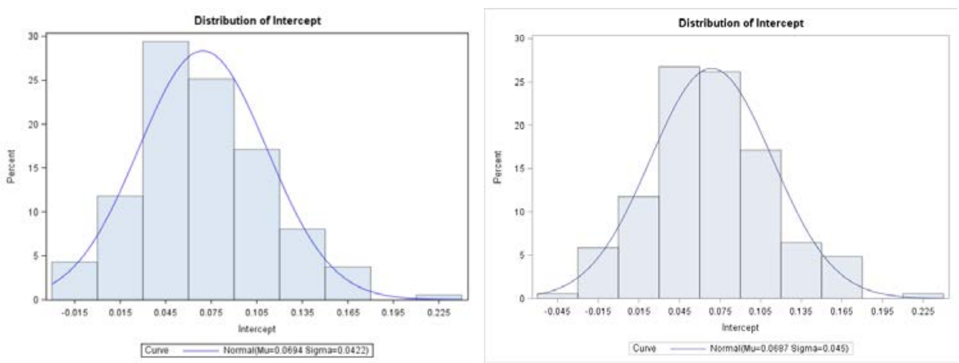
	ERA	Brav – Value Line	Brav – First Call	Individual Firm Level	Portfolio Level Decile	Portfolio Level Quintile
		US data		Australian data		
Intercept (Alpha)	0	0.07	0.20	0.07	0.07	0.07
(*t*-statistic)		(3.2)	(5.8)	(12.66)	(11.76)	(11.47)
Slope	0.06	0.07	0.07	0.01	0.01	0.01
(*t*-statistic)		(5.1)	(4.3)	(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').

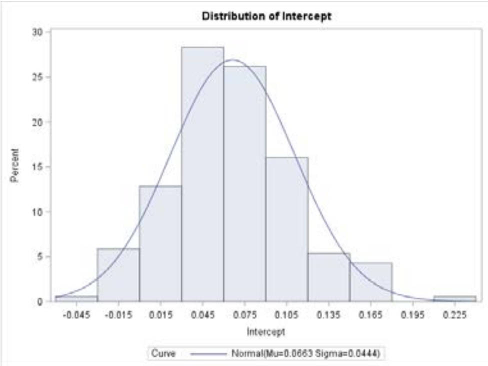
67 To ensure that the results are not driven by outliers, we examine the distribution of intercepts over time (an intercept is produced for the cross-sectional regression that is produced each month). The distributions of intercept terms for the various individual and portfolio specifications are set 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

[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,

[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-

[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:

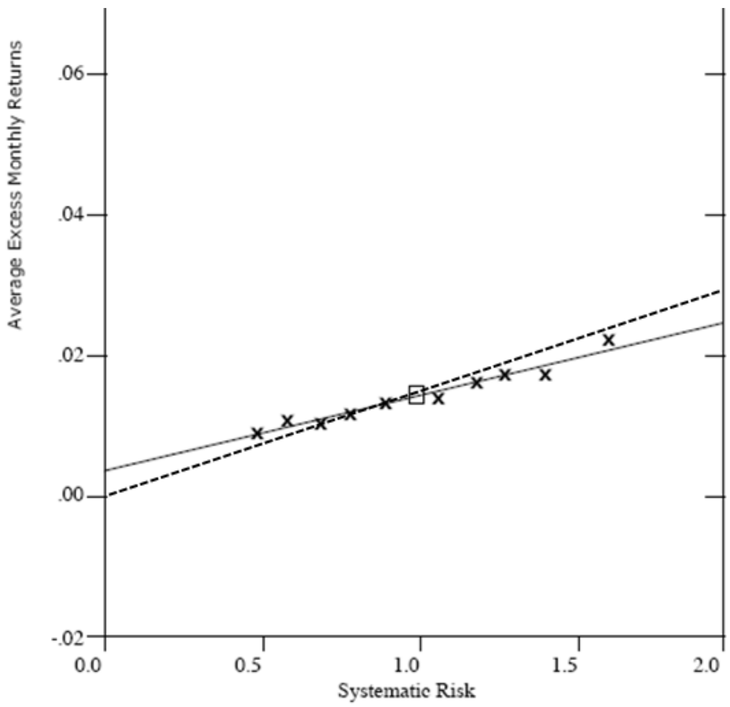
[47] Black, F., M.C. Jensen, and M. Scholes, 1972, "The Capital Asset Pricing Model: Some empirical tests," in *Studies in the Theory of Capital Markets,* Michael C. Jensen, ed., New York: Praeger, 79–121.

[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 $R_{\tilde{z}}$. 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.

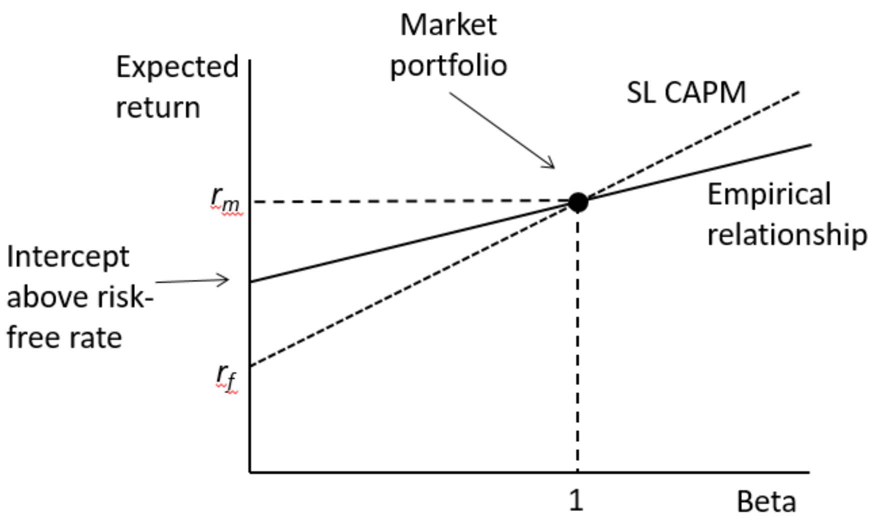
> These results seem to us to be strong evidence favoring rejection of the traditional form of the asset pricing model which says that Rz should be insignificantly different from zero.[52]

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.

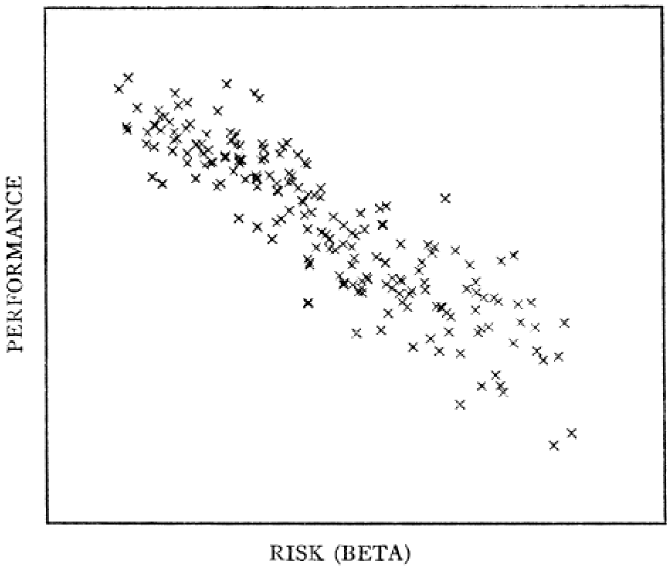
[54] Friend, I., and M. Blume, 1970, "Measurement of portfolio performance under uncertainty," *American Economic Review*, 60, 561–75.

[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.

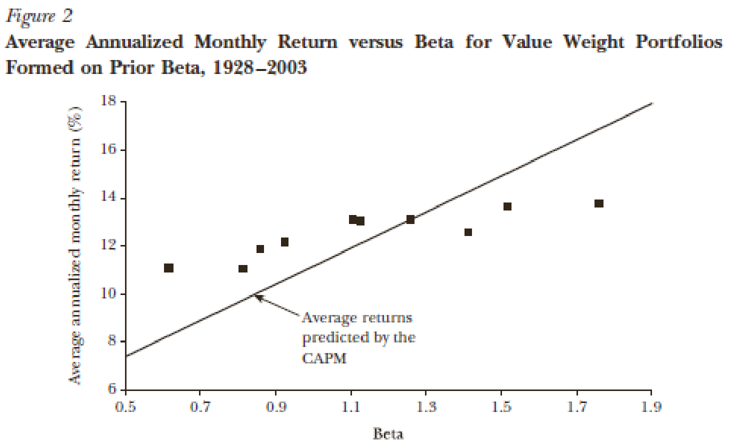
[61] Fama and MacBeth (1973), p. 632.

[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.

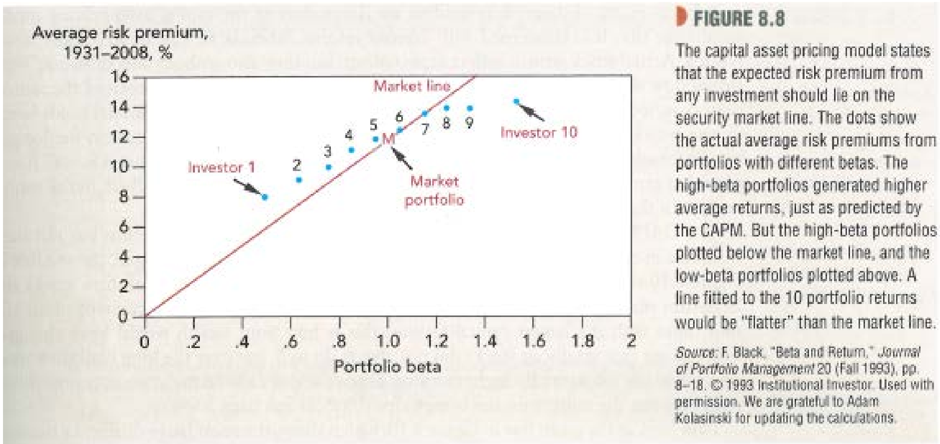
7.6 Brealey, Myers and Allen (2011)[63]

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



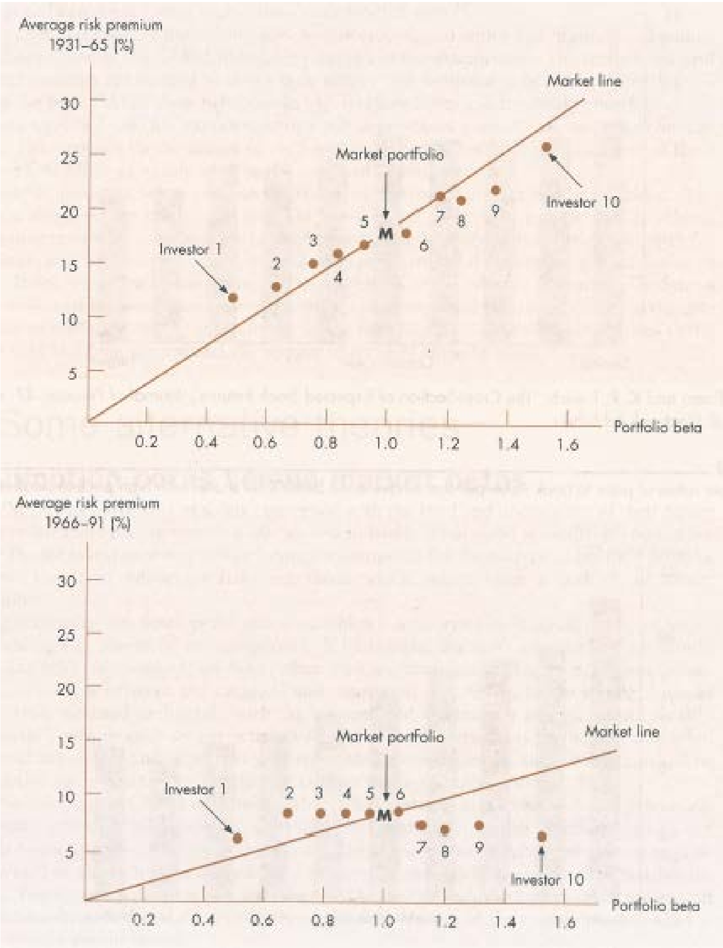
Source: Brealey, Myers, and Allen (2011), p. 197.

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):

$$(1 + ER_t^{VL})^4 = \frac{TP_t}{P_{t-9}} + \left(\frac{D}{P}\right)_H \cdot (1 + g_H) \cdot \left[\frac{(1+ER^{VL})^4 - (1+g_H)^4}{ER^{VL} - g_H}\right] \qquad (1)$$

  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:

$$(1 + ER_t^{VL})^4 = \frac{TP_t}{P_{t-9}} + \frac{Div_{next\ year} \cdot \left[\frac{(1+ER^{VL})^4 - (1+g)^4}{ER^{VL} - g}\right]}{P_{t-9}} \qquad (2)$$

  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:

$$1 + ER_t = \frac{TP_t + E_t(D_{t+1})}{P_t} \quad (4)$$

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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