Equity beta

REPORT PREPARED FOR AURIZON NETWORK

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1   Executive summary

1   Frontier Economics has been retained by Aurizon Network Pty Ltd (Aurizon Network) to provide expert advice in relation to Aurizon Network's regulated rate of return. In this report we consider the approach to estimating the equity beta for use in the Capital Asset Pricing Model (CAPM).[1]

2   At present, the Queensland Competition Authority (QCA) estimates that Aurizon Network has an equity beta of 0.8 for estimating Aurizon Network's equity risk premium.[2] The QCA's conclusion is based upon an asset beta estimate of 0.45.[3] The empirical basis for the QCA's beta estimates are regressions of stock returns on market returns for a sample of energy networks, with consideration also given to water networks, ports and toll roads. The basis for consideration of these industries is that they represent regulated networks. The QCA also considers that the type of regulation matters, specifically that firms facing a revenue cap are less risky than firms facing a price cap.[4]

3   The QCA explicitly rules out any consideration of the risks faced by coal companies and transport companies. Further, the QCA explicitly rules out application of the Black CAPM[5], and does not consider any other estimation technique or dataset, other than regressing stock returns on market returns. The empirical evidence that beta estimates from regressing stock returns on market returns leads to expected returns that fall below realised returns does not form part of the decision. Further, the characteristic of firms' book-to-market ratio, which prior research has shown to be positively associated with realised stock returns, has no bearing on the equity risk premium.

4   This means that the QCA estimates of asset beta and equity beta are based entirely upon:

a. **Comparable firms which are substantially different from, and likely to be less risky, than Aurizon Network.** The comparable firms share some characteristics (high leverage, no competing network) but are different on other important dimensions (exposure to a limited number of customers leaving the potential for asset stranding, value ultimately determined by demand for commodities). It is more likely that the risk exposure of Aurizon Network falls *between* that of regulated network

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[1] Sharpe (1964), Lintner (1965), Mossin (1966).

[2] UT4 final decision, p. 269.

[3] The asset beta is an estimate of the systematic risk exposure equity holders would face if the business took on zero debt. The equity beta is an estimate of the systematic risk exposure of equity holders, given the businesses' assumed leverage, which in the case of the QCA decision for Aurizon Network is 55%.

[4] UT4 final decision, p. 266.

[5] Black (1972).

businesses used by the QCA, and the risk exposure of rail and transport companies and other network owners with high customer concentration. This makes it likely that the QCA approach leads to an under-estimate of the cost of equity.

The basis for the QCA's selection of comparable firms is their status as a regulated network. However, the empirical evidence does not support the idea that one regulated network has the same risks as another regulated network. There is no substantial evidence that any particular intensity of regulation leads to a measurable difference in beta estimates. If business with high powered regulation show no differences in beta estimates compared to businesses with low powered regulation, we question the usefulness of the QCA's sole selection criteria of being a regulated network. The alternative view is that industry characteristics are important for estimating the risks to shareholders.

b. **An estimation technique and dataset (regressing stock returns on market returns) which has not been shown to lead to expected returns which are consistent with realised returns.** The evidence suggests that the realised returns for firms with regression-based beta estimates is higher than what is implied by the QCA approach. This makes it likely that the QCA approach leads to an under-estimate of the cost of equity.

c. **An estimation technique and dataset that ignores a firm characteristic (the book-to-market ratio) which prior evidence shows is positively associated with realised stock returns.** The evidence suggests that the QCA approach will under-estimate the cost of equity for a firm with a high book-to-market ratio.

5   In aggregate, our view is that the QCA's frame of reference for estimating the allowed return on equity is narrow and does not take into account important information about the cost of equity for Aurizon Network.

6   Our view is that the QCA's current equity beta allowance of 0.8, assuming 55% leverage, is unreasonably low because it does not account for four important pieces of information – sample composition, the empirical evidence on the realised returns of low beta stocks, the empirical evidence on firms with high book-to-market ratios, and the risks arising from customer demand elasticity, the nature of the customer base, and the exposure to a commodity with a volatile price. If any material weight is applied to any of these considerations the equity beta estimate will increase above 0.8.

2   QCA approach and equity beta estimate

7   In estimating the allowed return to equity holders the QCA makes the following three choices over estimation methods and data.

8   First, the QCA uses the Sharpe-Lintner CAPM, in which the QCA estimates three parameters:

   a. Risk free rate (r_f) – The expected return on a risk free investment.

   b. Market risk premium ($r_m - r_f$, or MRP) – The additional return investors expect for an investment in the market portfolio of all risky assets. The MRP can also be considered the risk premium for a typical equity investment given that the proxy for the market portfolio is the listed equity market.

   c. Equity beta (β_e) – How much systematic risk the equity holders face, relative to the systematic risk of the overall market, which can also be considered the systematic risk relative to the typical firm.[6]

9   The QCA has ruled out the use of an alternative model, the Black CAPM. This model is ruled out because of measurement challenges, and lack of use amongst other regulators.[7]

10   Second, in estimating beta to populate the Sharpe-Lintner CAPM the QCA relies upon a particular estimation technique. The QCA's estimate of beta is made by a regression analysis of stock returns on market returns. The slope of the regression line from this estimation technique is an estimate of beta.

11   Third, the QCA makes a decision on the characteristics of firms that it considers to be the best comparator firms to Aurizon Network. On this basis, the QCA relies upon beta estimates for firms involved in energy, water, ports and toll roads. The energy and water businesses are given most weight in the QCA's consideration, and the ports and toll roads businesses are used as cross checks by the QCA. The QCA has ruled out any consideration of beta estimates from rail infrastructure businesses or the broader suite of transport businesses.

12   The basis for the reliance on energy, water, ports and toll roads businesses is that they represent regulated network businesses. Rail and transport firms do not generally represent pure-play regulated networks. So the characteristic of being a regulated network is the sole basis for inclusion of a comparator firm, and the characteristic of being a rail or transport firm has no relevance to the QCA's decision on equity beta.

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[6] The Capital Asset Pricing Model states that the expected return on an investment = risk free rate + the equity beta of the investment × the market risk premium. Expressed as an equation for investment i we have $r_i = r_f + \beta_i \times (r_m - r_f)$ where r_f is the risk free rate, r_m is the expected return on the market portfolio of all risky assets and β_i is the systematic risk of investment i.

[7] UT4 Final decision, p. 265.

13   The QCA also considers that the characteristic of the revenue cap is important in that this reduces the risk to Aurizon Network in comparison to a non-revenue cap regime. The introduction of the revenue cap was cited by the QCA as one reason for lowering Aurizon Network's equity beta estimate from 0.9 to 0.8 in the QCA's 2010 decision.[8]

14   On the basis of these considerations the QCA's most recent decision is an equity beta estimate of 0.8.[9] The QCA's considerations in estimating the equity risk premium are summarised in Table 1.

Table 1. QCA considerations and conclusions in estimating the equity risk premium

Information	Relevant	Not relevant
Model	Sharpe-Lintner CAPM Why? Use by regulators and corporations, simple to apply and easy to understand[10]	Black CAPM Why? Estimation problems and non-use by other regulators
Estimation technique	Regression of stock returns on market returns Why? Standard practice	Other firm characteristics including book-to-market ratio Why? Not considered
Comparable firms	Energy Water Ports Toll roads Why? Regulated network	Rail Transport Why? Not regulated networks
Other information	Revenue cap Why? Revenue cap reduces volatility of cash flows.	

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[8] UT4 Final Decision, p. 266.

[9] The QCA's underlying assumptions are an asset beta estimate of 0.45, leverage of 55%, debt beta of 0.12, corporate tax rate of 30% and gamma of 0.47. The figure of 0.47 for gamma represents the QCA's estimate of the value of corporate tax paid. Applying the QCA's formula for the relationship between asset beta and equity beta we have equity beta = asset beta × {1 + debt/equity × [1 − tax rate × (1 − gamma)} − debt beta × debt/equity × [1 − tax rate × (1 − gamma] = 0.45 × {1 + 0.55/0.45 × [1 − 0.30] × (1 − 0.47)} − 0.12 × 0.55/0.45 × [1 − 0.30 × (1 − 0.47)] = 0.45 × 2.03 − 0.12 × 1.03 = 0.91 − 0.12 = 0.79. This is approximately 0.8.

[10] UT4 Final Decision, p. 205.

3   Reasonable basis for decision-making

15   In this report we address the over-arching question raised by the contextual discussion above, **"Is there any reasonable basis to rely upon an equity beta estimate of 0.8 based upon the criteria summarised in Table 1?"**

16   Our view is that the QCA has already been given substantial evidence that its current approach is unreasonably narrow. The objective is to estimate the additional return that an equity investor would expect to earn from investing in Aurizon Network, relative to what that investor would earn in an average investment. As we discuss below:

a.   there is no empirical evidence that the form of regulation can be used to distinguish equity risks amongst firms, and

b.   there is evidence that the QCA's estimation technique leads to cost of equity estimates that are systematically too low compared to actual returns across time and in different markets.

17   The most that we can reasonably conclude from the QCA analysis is that 0.8 represents an estimate of the past association between stock returns and market returns for listed energy and water networks.[11] To make the conclusion that multiplying 0.8 by the estimate of the market risk premium represents a reliable estimate of the equity risk premium requires conjecture which is inconsistent with the evidence already presented to the QCA.

3.1   Comparable firms

18   With respect to comparable firms, both Aurizon Network and the QCA understand that they cannot analyse a large sample of listed, regulated, pure-play rail networks. These firms do not exist. Given that regulated energy and water businesses, and unregulated rail and transport businesses, share characteristics of Aurizon Network (lack of network competition for energy and water, industry and customer concentration for rail and transport) it was previously proposed by Aurizon Network[12] that the equity beta estimate should be based upon a broader suite of comparable firms. The best equity beta estimate would lie somewhere

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[11] The regression of stock returns on market returns results in a regression coefficient which is the covariance of stock returns on market returns, scaled by the variance of market returns. So it is a relative measure of how past stock returns have moved with market returns.

[12] SFG Consulting (2012). That report does not consider the empirical evidence relating to the realised returns on low beta stocks and the empirical evidence on the realised returns to stocks with high book-to-market ratios. The book-to-market ratio formed part of the analysis, but in a different way. We used the book-to-market ratio as a characteristic to identify firms as being similar to Aurizon Network and examined how the relationship between stock returns and market returns varied depending upon the firms' book-to-market ratio. That analysis is different to analysis which examines whether, on average, firms with high book-to-market ratios earn above-average returns.

between the equity beta estimate for energy and water networks, and the equity beta estimate for rail and transport firms.

19   One key issue is whether any regard should be had to other rail infrastructure companies or transport companies. This issue is material in that the equity beta estimates for other rail infrastructure companies are substantially higher than the QCA's equity beta allowance. The only way to support an equity beta as low as that allowed by the QCA is to place no reliance on the evidence from other rail infrastructure firms – which is what the QCA has done. The application of even a small amount of weight to the evidence from other rail firms would support a beta higher than the QCA's allowance.

20   The QCA, via its consultant Incenta[13], applied its judgment to rule out placing any weight at all on other rail infrastructure companies. The rationale for this approach was Incenta's view that the systematic risk of the Central Queensland Coal Network is not related to the fact that it is a rail network but rather is related to the fact that it is regulated. This led the QCA to select comparators on the basis that they are regulated rather than on the basis that they are involved in the rail infrastructure business.

21   In its UT4 Final Decision, the QCA noted that it had received comment from consultants, including ourselves, that other regulators, credit rating agencies, and independent valuation experts all have regard to other rail infrastructure businesses.

22   In relation to other regulators, the QCA summarised a point raised by the Brattle Group:

> ERA(WA)—in 2013 and 2014, the ERA determined an equity beta of 1.43 for Pilbara Infrastructure and an equity beta of 1.0 for Brookfield Rail.
>
> Canadian Transportation Agency (CTA)—like the QCA, the CTA determines the cost of equity for railroads with a single bulk commodity (i.e. grain). As a result, the equity betas of Canadian National (1.01) and Canadian Pacific (1.30) railroads are relevant and warrant some weight.[14]

23   In relation to independent experts, the QCA summarised a point that we raised in that the QCA had:

> Included an asset beta estimate of 0.35, based on an independent expert's (i.e. Grant Samuel's) assessment of the beta for DBCT
>
> excluded from consideration that 'the *same* independent expert, in the *same* report' (SFG's emphasis) made an estimate for the equity beta for WestNet Rail (now Brookfield Rail) of 1.0 to 1.1, even though WestNet Rail shares a number of similarities with Aurizon Network.[15]

24   In relation to credit rating agencies, the QCA summarised our point that:

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[13] Incenta Economic Consulting (2013).

[14] UT4 Final Decision, p. 254.

[15] UT4 Final Decision, p. 253.

Standard and Poor's:

- – relied upon the same WA rail network in its analysis of the CQCN, and also considered other transportation businesses

- – did not include energy networks in its analysis.[16]

25   In its UT4 Final Decision, the QCA dismisses the fact that its approach of disregarding all rail infrastructure firms and relying instead on water and energy utilities is unique, as follows:

a. In relation to regulators having regard to rail infrastructure companies, the QCA simply restates its assumption that other rail infrastructure companies are not appropriate comparators – even those that have more than a quarter of their revenues subject to regulation;[17]

b. In relation to independent experts, the QCA observes that Grant Samuel applied different betas for rail infrastructure companies and utilities.[18] Given the QCA's conclusion that the Central Queensland Coal Network (CQCN) is a utility rather than rail infrastructure, this leads the QCA to conclude that the Grant Samuel report supports the QCA approach; and

c. In relation to credit rating agencies, the QCA concludes that whereas other rail infrastructure companies may be similar to the CQCN in terms of credit risk, this does not imply that they are also similar in terms of equity risk.[19] That is, whereas the risk facing debt holders is similar, the risk facing equity holders might be so different that the other rail infrastructure companies should receive no weight at all.

26   The fact that the QCA's approach runs counter to that adopted by other regulators and market participants is not, in itself, evidence that the QCA's approach is wrong or unreasonable. Rather, an assessment must be made of the rationale for the QCA's approach. If the departure from the conventional approach is well reasoned and justified by evidence, it should be supported. By contrast, if it is based on assumption or assertion, it should not.

27   The QCA's reliance on water and energy utilities to the exclusion of other rail infrastructure companies is based on the "first principles" considerations of Incenta. Incenta's view is that the systematic risk of the CQCN is not due to its industry characteristic of being a rail network, but rather is related its status of being a regulated network. Incenta's view is that it is the existence of regulation that has the dominant effect on equity risk and that the type of industry is

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[16] UT4 Final Decision, p. 253.

[17] UT4 Final Decision, p. 262.

[18] UT4 Final Decision, p. 261.

[19] UT4 Final Decision, p. 261.

irrelevant – that regulated firms in a different industry are suitable comparators and that unregulated (or partially regulated) firms in the same industry should be disregarded.

28   Incenta's conclusions are presented as a "first principles analysis."[20] This involves a conceptual discussion about the possible uncertainty of future cash flows and results in Incenta concluding that the risk of cash flows generated by making rail lines available to a small number of mining companies is equivalent to the risk of cash flows generated by distributing electricity to households. Aurizon Network's submission considered the same "first principles" and reached the opposite conclusion. Because this all involves nothing more than conceptual discussion, there is no framework for determining whose conclusion is correct.

29   The problem is that there is a very important suite of empirical analysis which sheds some light on this issue. With respect to the impact of regulation on systematic risk, the QCA has been presented with information from Incenta[21] and from us[22] that there is *no empirical evidence that equity beta estimates depend upon the form of regulation.* This point is important to understand because it goes to the heart of the QCA's basis for estimating the allowed return to equity holders.

a.   There is no empirical evidence that equity beta estimates, compiled using the same estimation technique as the QCA, differ according to the form of regulation. It does not matter whether regulation offers high or low powered incentives, or whether a price cap or revenue cap is involved – different types of regulation do not show up in the data as leading to different beta estimates.

b.   The common characteristic to Aurizon Network used by the QCA in selecting comparable firms is that of being a regulated network.

c.   Yet if firms in the same industries under different forms of regulation have similar beta estimates, this suggests that industry is at least one relevant criteria for analysis.

30   In sum, the regulation of energy networks, water networks, ports and toll roads is different, and according to the QCA's estimation technique these industries have different risks (that is, different betas). Firms exposed to high-powered versus low powered regulation do not have different risks (that is, different betas). But the comparable firm set is selected without consideration of industry, but with consideration of the firm's status of being regulated. In our view, industry characteristics – rail & transport industry, customer concentration, and exposure to a particular type of customer (mining) – do matter and this leads to the QCA under-estimating the risk of Aurizon Network.

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[20] Incenta (2013), p. 7.

[21] Incenta (2013).

[22] SFG Consulting (2014), Table 2.

3.2   Nature of risk

31   The previous sub-section focussed on the point that the QCA has determined that the form of regulation is <u>the</u> primary determinant of systematic risk when there is no empirical evidence to support that proposition, just conjecture and assertion. This has led the QCA to set its equity beta allowance on the basis of regulated energy and water network businesses.

32   In this sub-section, we consider a number of important differences between the CQCN and regulated energy and water businesses insofar as they affect the systematic risk of equity in those businesses.

Customer demand elasticity

33   Regulated water and electricity businesses distribute essential commodities to largely residential customer bases. These customers have no viable option other than to pay the network business for providing the essential service. For most consumers, the only realistic option is to reduce consumption, but given the essential nature of electricity, gas and water, the ability to materially decrease consumption is very limited. Consequently, the price elasticity of demand is relatively very low for these businesses.

34   By contrast, the price elasticity of demand is likely to be much higher for the CQCN. This is because customers do have realistic alternatives in responding to price increases. These alternatives include securing access to alternative existing rail links and/or funding new spurs and connections (possibly to different ports). Another (longer term) alternative is to reduce contracted volumes.

35   Finally, we note that the coal mining companies that are the customers of the CQCN are likely to be more sensitive to price during periods when coal prices are lower, coinciding with a downturn in the Australian market.

Nature of the customer base and the service being provided

36   For regulated energy and water networks, the proportion of customers who cease paying for the service (i.e., disconnect from the network) is negligible. The largely residential customer base tends to maintain its connection to the network continuing to pay network charges.

37   By contrast, the CQCN provides a commercial service. Customers only continue to pay so long as that course of action remains commercially optimal. This is very different from the provision of a service that is essential to maintain life.

38   Whereas losses that arise from disconnecting customers can be socialised in both cases, such socialisation is practically more difficult in the case of the CQCN where the disconnection of a single customer might amount to 10% of the revenue base.

39   Finally, we note that there is a systematic element as the risk of losses from disconnections is more likely to arise during market downturns.

Volatility in coal prices

40   As noted above, the CQCN provides a commercial service to a small number of coal mining companies rather than an essential service to a large number of residential customers. CQCN customers will only remain as customers while it remains commercially optimal for them to do so. The main driver of the commercial position of these customers is the coal price, which is known to be volatile. Thus, the CQCN is subject to the risk of a prolonged decline in coal prices. This type of risk is not something that is faced by regulated energy and water networks. Moreover, there is a systematic nature to this risk as a prolonged reduction in coal prices is more likely to occur during a downturn in the broad Australian market.

Conclusions on the nature of risk

41   The point we are making here is simply that there is more to systematic risk than the form of regulation. There are a number of other factors that are relevant to systematic risk. In this sub-section, we show that there are a number of factors that are likely to have a different effect on the systematic risk of the CQCN than on regulated energy and water businesses. Our conclusion is that, whereas regulation is *a* relevant factor to consider, it is not *the only* relevant factor. It is for this reason that we recommend that the comparator set be extended beyond *only* regulated energy and water businesses.

3.3   Using unadjusted beta estimates in the CAPM

42   Even if the "correct" set of comparator firms has been selected, it is well-known and generally accepted that the process of estimating equity betas via regression analysis and inserting those estimates into the CAPM formula produces outputs that are systematically biased. In particular, there is strong and consistent evidence that the CAPM estimates of the required returns on assets with beta estimates below 1.0 are systematically lower than the returns that are actually generated by those assets.

43   This evidence is generally considered to be so robust that it is now part of the standard finance curriculum and appears in the academic literature and the standard finance textbooks. For example Fama and French (2004) show that this result has proven to be consistent through time – low-beta stocks generate higher returns than the Sharpe-Lintner CAPM would imply and high-beta stocks earn lower returns than the Sharpe-Lintner CAPM would imply. With respect to the early tests of the Sharpe-Lintner 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."[23]
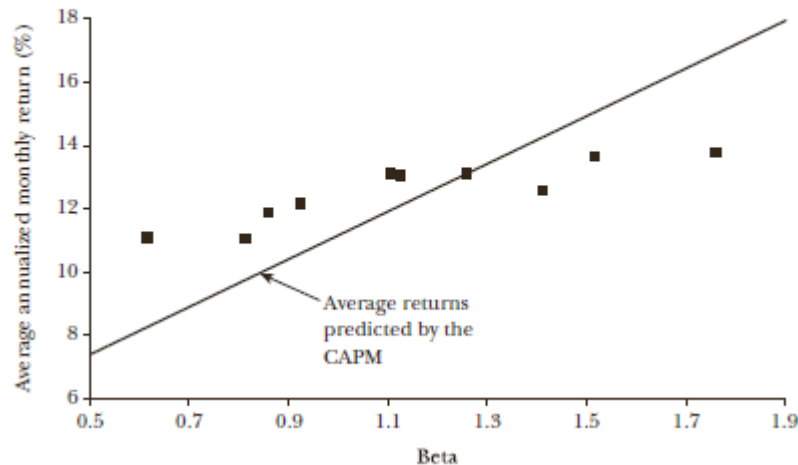
[23] Fama and French (2004), p. 32.

44   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 1 below. Consistent with the early evidence, realised returns on low-beta stocks are higher than predicted by the Sharpe-Lintner CAPM, and realised returns on high-beta stocks are lower than predicted by the Sharpe-Lintner CAPM. Stocks with the lowest beta estimates (approximately 0.6) had average returns of 11.1% per year, but the Sharpe-Lintner CAPM says the expected return was 8.3% per year. Stocks with the highest beta estimates (approximately 1.8) had average returns of 13.7% per year, but the Sharpe-Lintner CAPM says the expected return was 16.8% per year.

Figure 1. Average returns versus beta over an extended time period

Figure 2
Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on Prior Beta, 1928–2003

Source: Fama and French (2004), p. 33.

45   Brealey, Myers and Allen (2011) extend 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[24] on the vertical axis. This chart is presented below in Figure 2. The line represents the relationship between beta and excess return that is implied by the Sharpe-Lintner CAPM and each dot represents the observed return for a particular portfolio. Clearly, the low-beta portfolios still earn higher returns than the Sharpe-Lintner CAPM would imply.

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[24] Excess returns are returns in excess of the risk free rate of interest.

Final   Reasonable basis for decision-making

Figure 2. The relationship between excess returns and beta
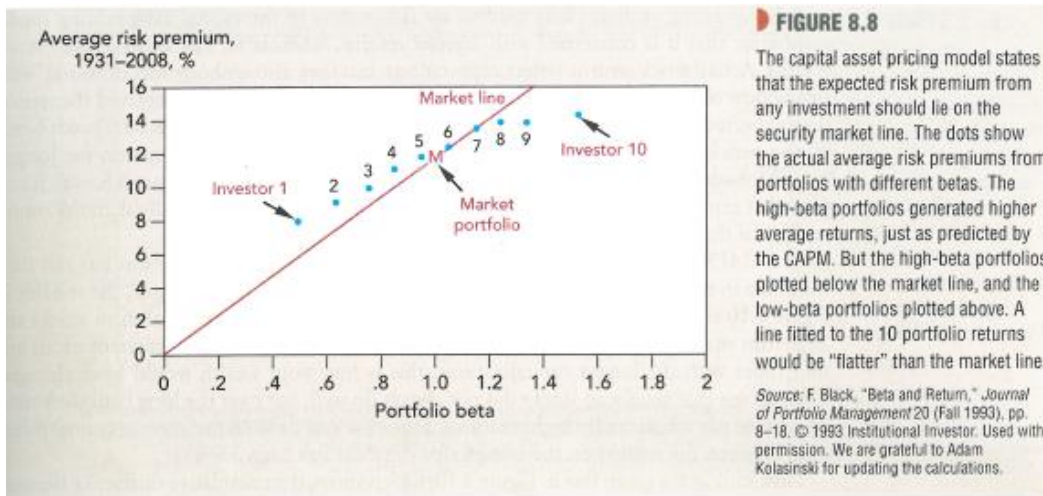
Source: Brealey, Myers, and Allen (2011), p. 197.

46   The same result is implied by analysis of industry beta estimates, as shown in Figure 3 from Da, Guo and Jagannathan (2012). On the left hand side we see a flat line of best fit between industry beta estimates and excess returns. On the right hand side we see an upward sloping relationship between industry beta estimates compiled using a different estimation technique proposed by the researchers. The basis for the researchers' paper is that, if we are going to use the Sharpe-Lintner CAPM as a basis for estimating expected returns, we need a risk estimate which is not simply compiled by regressing stock returns on market returns.

Figure 3. Industry beta estimates and excess returns
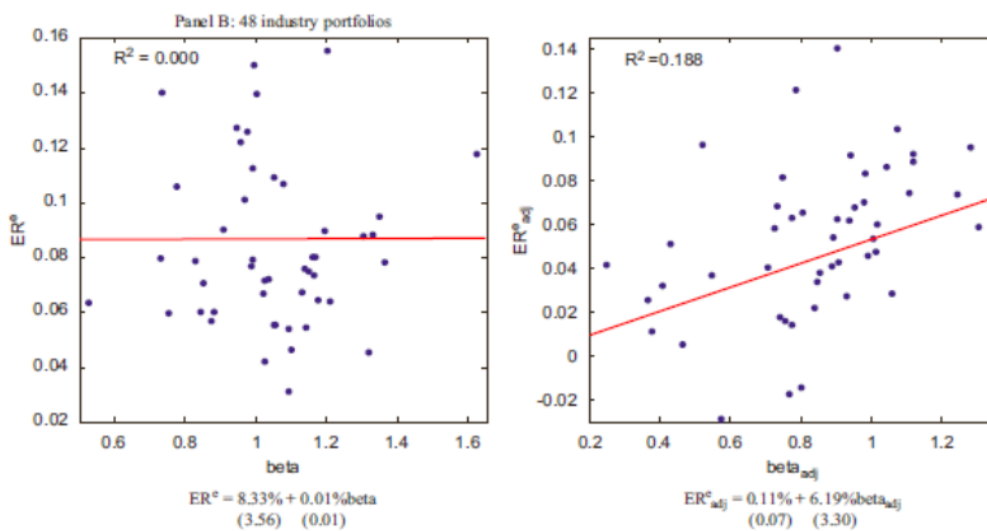
Source: Da, Guo and Jagannathan (2012), p. 217 (lines of best fit added)

47   The key point is that the beta estimates adopted by the QCA are formed by simply regressing stock returns on market returns. As a result of this estimation technique the expected returns over a very long period of time fall short of realised returns.

Reasonable basis for decision-making   Final

48   We performed our own analysis of the relationship between beta estimates and realised returns for a sample of 212 Australian-listed firms. We analysed a set of firms for which at least 50 weekly returns were available in three consecutive time periods (six years from 1 July 1992 to 30 June 1998, six years from 1 July 1998 to 30 June 2004, and 1 July 2004 to 30 June 2012).

49   The first time period is used to partition the sample into ten cohorts according to beta estimates. Each cohort is constructed so it has approximately the same industry composition, the same number of large versus small firms, and the same number of firms with high and low book-to-market ratios.[25] This step is *not* to introduce industry, size and book-to-market ratio into the cost of capital estimation – quite the opposite. It is to ensure that our results are *not contaminated* by different portfolios having different characteristics of industry, size or book-to-market ratio.

50   Having allocated stocks into 10 portfolios according to beta estimates we then estimate portfolio beta estimates in the second time period. This means for each portfolio we regress portfolio returns on market returns to estimate the risk of that portfolio. We then need to see whether the portfolios' beta estimates show any relationship with realised stock returns over the final 12 year period.

51   The results are summarised in Figure 4. The results show that portfolios with high beta estimates performed no better than portfolios with low beta estimates. The relationship between beta estimates and realised returns is slightly downward-sloping and is not statistically significant. This does not mean that high beta stocks have a lower cost of capital than low beta stocks. In the figures of Fama and French (2004) and Brealey, Myers and Allen (2011) the relationship between beta estimates and returns has a slight upwards relationship. In the figure of Da, Guo and Jagannathan (2011) there is a flat relationship between beta estimates and stock returns. The evidence is simply that regressing stock returns on market returns does not lead to beta estimates which show a reliable, positive association with stock returns.

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[25] There are ten industry groups formed accounting to the first level of the Industry Classification Benchmark. There are two size groups formed according to the 60th percentile of market capitalisation in our sample, with the 60th percentile selected in order to ensure a reasonable spread of firms across the final 10 beta portfolios (that is, not too many or too few firms in each decile). There are two book-to-market groups formed according to the 50th percentile of book-to-market ratio. This means that a firm could be allocated into one of 40 groups according to 10 industries × 2 size groups × 2 book-to-market groups, and some groups have more firms than others. Within each of the 40 groups we rank the firms according to each firm's beta estimate and classify it into one of ten beta cohorts. We then bundle all the firms within beta cohort 1 together, all the firms in beta cohort 2 together and so on. This means that firms in the low beta cohort contain firms with low beta estimates from many different industries, large and small firms, and high and low book-to-market firms. Across the 10 beta cohorts the industry, size and book-to-market allocation is similar.

Figure 4. Beta estimates and realised returns for Australian-listed firms
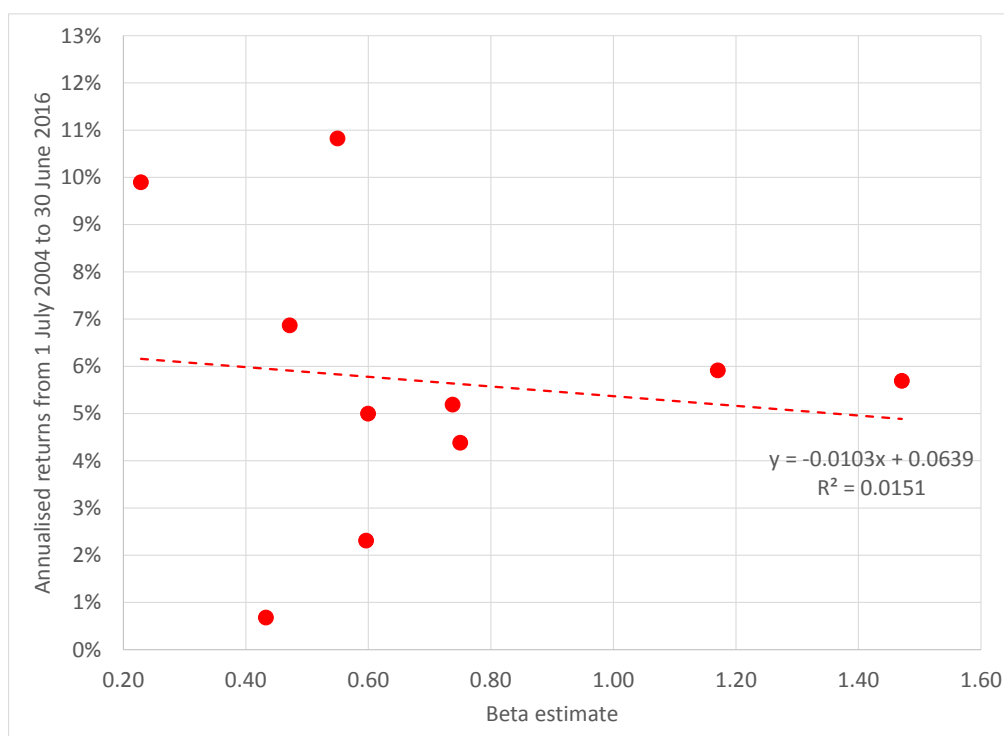
Evidence similar to that summarised in the figures above has been presented to the QCA as justification for an alternative model to the Sharpe-Lintner CAPM, the Black CAPM. In this model, the expected returns to low beta stocks are increased and the expected returns to high beta stocks are decreased. The QCA has ruled out the use of the Black CAPM, and the QCA's estimate of equity beta is the QCA's best estimate[26] of equity beta for use in the QCA's preferred model.

So we are left with a technique for estimating beta which generates an estimate which we know is low, compared to what is implied by the realised returns of other stocks with beta estimates below one. In one sample of data we will not necessarily see a robust relationship between beta estimates and realised returns. But researchers have now been able to address this question with data samples over a long period of time and in different equity markets. And it is not the case that regressing stock returns on market returns leads to risk estimates that show a reliable relationship with realised returns. At some point the data needs to carry weight in decision-making.

In contrast, there is a variable that has been consistently shown in the literature to have a positive relationship with realised returns – the ratio of the book value of equity to the market value of equity. We repeated the analysis presented above for portfolios formed according to book-to-market ratio, with each portfolio having similar composition in terms of industry, beta estimate and size. In Figure 5 we show the relationship between the portfolios' average book to market ratio over the period 1 July 1998 to 30 June 2004, and the annualised returns over the

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[26] UT4 Final Decision, 268.

subsequent 12 years. Consistent with prior evidence[27], this relationship is positive.[28]

Figure 5. Book to market ratio and realised returns for Australian-listed firms
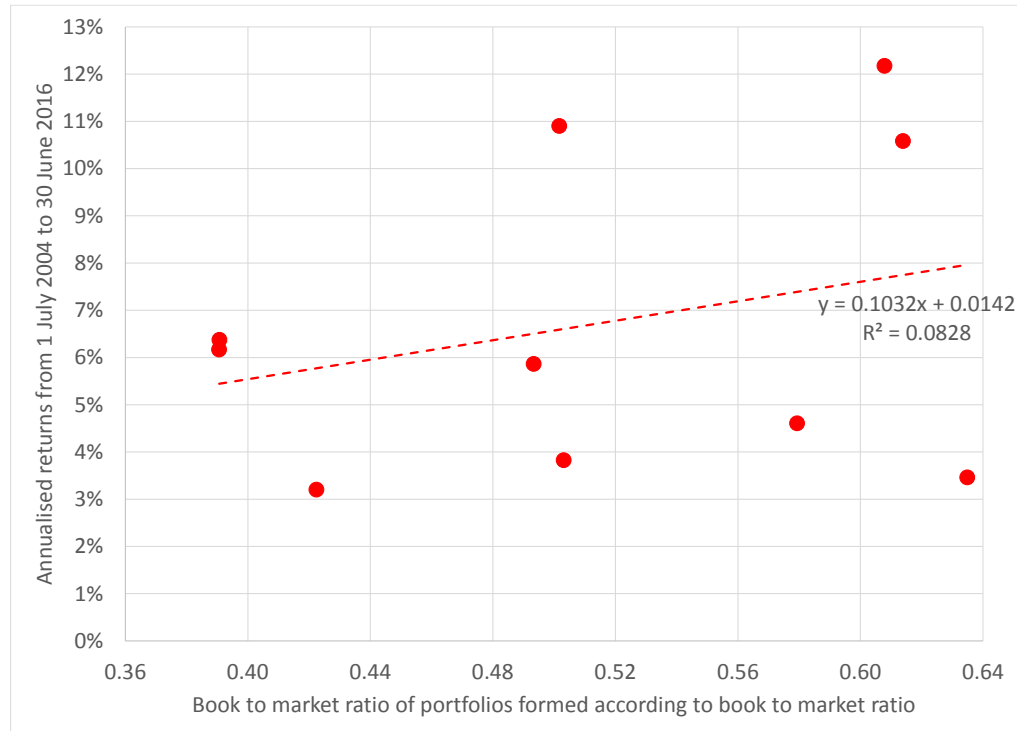
55   In the current analysis we have not been asked to present an alternative asset pricing model to the Sharpe-Lintner CAPM. We have been asked to arrive at an estimate of beta based upon the prior evidence presented to the QCA, and the information presented in this report, that would allow Aurizon Network to earn a return equal to its cost of capital.

56   What is clear is that, if the beta estimate is set on the basis of:

    a.   Regressing stock returns on market returns;

    b.   For a sample of energy networks (with consideration of water networks, ports and toll roads);

    c.   And no other information is taken into account, including the likelihood that Aurizon Network has a relatively high book-to-market ratio; then

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[27] Fama and French (1992), Brailsford, Gaunt and O'Brien (2012).

[28] In our prior work for Aurizon Network – SFG Consulting (2012) – we did not consider the empirical evidence relating to the realised returns on low beta stocks and the empirical evidence on the realised returns to stocks with high book-to-market ratios. The book-to-market ratio formed part of the analysis, but in a different way. We used the book-to-market ratio as a characteristic to identify firms as being similar to Aurizon Network and examined how the relationship between stock returns and market returns varied depending upon the firms' book-to-market ratio. That analysis is different to analysis which examines whether, on average, firms with high book-to-market ratios earn above-average returns.

Final   Reasonable basis for decision-making

      d. The allowed return on equity will fall below the cost of equity for Aurizon Network.

57   It is implausible that the empirical evidence relating to beta estimates, book-to-market ratio and realised returns, is a chance result given its persistence over time and across markets. The empirical evidence could be the result of two things.

      a. A *model* (the CAPM) which is incomplete – risks other than systematic risk could be important for stock returns (and those risks could be proxied by the book to market ratio); and/or

      b. An *estimation approach* (regressing stock returns on market returns) which doesn't reflect the actual risks investors face.

58   Regardless of the reason for the empirical result, it is important that allowed returns incorporate risks that investors actually incorporate into asset prices, and not the risks that a single theory says that investors should incorporate into asset prices. Our view is that if the equity return continues to be set on the basis of the limited information relied upon by the QCA (in terms of model, estimation technique and sample firms) then the QCA will have left out material, relevant information in estimating Aurizon Network's allowed return.

4   Conclusion

59   We consider that if the QCA adopts the Sharpe-Lintner CAPM for estimating the allowed return on equity, an appropriate beta estimate for the Aurizon Network is above the current allowance of 0.8. Our conclusion is based upon the following rationale. If any one of the considerations listed below are given material weight in decision-making the equity beta estimate would increase above 0.8.

Sample composition

60   Aurizon Network shares some characteristics of other infrastructure networks (high leverage, no competing network) and some characteristics of rail and transport companies (exposure to a limited number of customers leaving the potential for asset stranding, value ultimately determined by demand for commodities). So the risks to shareholders will lie somewhere between the risks of other infrastructure networks and that of rail and transport companies.

61   It is not the case that one regulated infrastructure network has the same risks as another regulated infrastructure network. There is no substantial evidence that any particular intensity of regulation leads to a measurable difference in beta estimates. If businesses with high powered regulation show no differences in beta estimates compared to businesses with low powered regulation, we question the usefulness of the QCA's sole criteria for sample selection – status of being a regulated network. The alternative view is that industry characteristics are important for estimating the risks to shareholders, yet industry is ignored in the QCA's decision on Aurizon Network's allowed return.

62   Importantly, according to the QCA's risk metric (beta) risks are different amongst energy, water, ports and toll roads. So industry does seem to matter for risk. Yet industry does not factor into the QCA's selection of comparable firms. In contrast, differences in regulation have not shown up in different beta estimates in prior research, so it is highly questionable whether we can conclude that the distinction between being regulated versus unregulated is the primary determinant of risk.

63   Whether or not the QCA applies any precise weight to different samples is not the point of this conclusion. Our point is that:

   a.   the QCA's conclusions do not fully account for the risks facing Aurizon Network, which differ from those facing the infrastructure samples the QCA has relied upon. Whereas regulation is *a* relevant factor to consider, it is not *the only* relevant factor;

   b.   the sample firms that share characteristics of Aurizon (transport and rail) have notably higher asset beta estimates than the 0.45 beta estimate the QCA ascribes to a regulated infrastructure firm; and

    c.   even if a low weight is applied to an expanded set of comparator firms, the implied equity beta estimate for the Aurizon Network is above 0.8.

Empirical evidence on the realised returns of low beta stocks, and high book-to-market stocks

64   Low beta stocks, over a long period of time, have earned returns higher than predicted by the QCA's application of the CAPM. The combination of model (CAPM) and estimation technique (regressing stock returns on market returns) leads to cost of equity estimates that fall below realised equity returns for stocks with low beta estimates. This result has been shown to hold consistently over time and across markets.

65   High book-to-market stocks, over a long period of time, have earned returns higher than predicted by the QCA's application of the CAPM. The characteristic of having a high book-to-market ratio does seem to matter to investors when it comes to pricing assets. The persistence of this result suggests that it cannot be considered mere chance and its relevance to estimating allowed returns should be considered.

66   The evidence suggests that either:

    a.   The CAPM is a model that is incomplete; and/or

    b.   the estimation technique leads to poor risk measurement.

67   Either way, the QCA's prior beta estimate of 0.8 has not taken this important empirical evidence into account, and if that evidence was accounted for the beta estimate would increase.

Conclusion   Final

5   References

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