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Australian Energy Regulator

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APA submission on CAPM and alternative return on equity models

APA Group (APA) has reviewed the draft working papers, *CAPM and alternative return on equity models*, and *International regulatory approaches to rate of return*, which were published by the Australian Energy Regulator (AER) in August 2020. We have also read the related expert reports, *Alternative asset pricing models*, prepared by Professors Partington and Satchell, and *International regulatory approaches to the rate of return*, prepared by The Brattle Group.

We understand the view in the equity models working paper that the Sharpe-Lintner capital asset pricing model (CAPM) should play a major role in determination of the return on equity in the 2022 Rate of Return Instrument. The reasons advanced for this view are, however, open to question.

We acknowledge the implementation problems which have led the AER to reject the use of the dividend growth model, but still see that model as having an important role to play, not as an alternative to the CAPM, but as a companion to it.

Use of the CAPM requires estimation of the parameter beta, but estimates of realised betas may not be best estimates of the ex ante betas to be used in a "forward-looking" asset pricing model like the CAPM. If statistical estimation of realised betas is to inform beta estimates, that estimation should use five years of monthly data. However, this will have the implication that estimates made using 2022 and earlier data will be obsolete by 2026.

We agree with the conclusion of the equity models working paper that, on balance, there continues to be a range of issues which limit the use of international comparators for rates of return. But there are now only three listed electricity network and gas pipeline service providers which can be examined for beta estimation. Data for similar businesses operating in other jurisdictions may, if used carefully, assist in overcoming the problem of a small Australian sample.

In the following paragraphs we elaborate on these issues.

A major role for the CAPM

As the equity models working paper notes, the CAPM has clear theoretical foundations based on finance and economic principles, and methods for its implementation which are well-established. In contrast, the alternatives to it – the other asset pricing models that have "track records" in the financial economics literature (Black CAPM, Fama-French three factor model, consumption CAPM) – have, as Professors Partington and Satchell advise, significant conceptual and implementation problems. Nevertheless, continuing research, in new directions, clearly indicates that asset pricing remains an important and largely unsettled issue: the alternatives may have significant problems, but the CAPM is not the accepted model of asset pricing.

The CAPM is widely used because it is simple, can be understood by a wide audience, and data required for its implementation are easily obtained. It is, as the equity models working paper advises, predominant. But this is not because the model provides good estimates of rates of return. Neither the working paper, nor the report from Professors Partington and Satchell, tell us much about whether the CAPM is capable of providing the right estimates of the rates of return on equity required for determining the costs, and setting the prices, of regulated electricity network and gas pipeline service providers.

The CAPM is derived from a very simple model of general equilibrium in an exchange economy. The agents whose behaviour is modelled make portfolio decisions today knowing the expected returns, one period ahead, on the risky assets which comprise those portfolios. The expected return on each asset is the same for all agents (expectations are homogeneous). One of the assets is risk free. There is no production or consumption in the "CAPM economy". There is a time dimension, but the general equilibrium model from which the CAPM is derived is not dynamic: time does not enter into portfolio decisions and the pricing of assets in any essential way.

The CAPM provides an important insight into the way in which risk might be incorporated into asset prices. But its derivation in a very simple static general equilibrium setting means that the CAPM captures little of the complexity of real-world asset markets.

In 2004, Eugene Fama and Kenneth French observed:

The CAPM, like Markowitz's (1952, 1959) portfolio model on which it is built, is nevertheless a theoretical tour de force. We continue to teach the CAPM as an introduction to the fundamental concepts of portfolio theory and asset pricing, to be built on by more complicated models like Merton's (1973) ICAPM. But we also warn students that despite its seductive simplicity, the CAPM's empirical problems probably invalidate its use in applications.[1]

More recently, Oxford University emeritus Professor John Kay, and former Governor of the Bank of England, Mervyn King, have cautioned:

Portfolio theory, the capital asset pricing model and the efficient market hypothesis are useful, indeed indispensable, models, but none of them describe 'the world as it really is'. When people take these financial models too literally, populate them with invented numbers and base important decisions on them, the models become misleading, even dangerous.[2]

Why, then, is the CAPM predominant?

The ease of transmitting simple ideas may drive the evolutionary success of surprisingly naïve financial strategies.[3]

The reasons for the predominance of the CAPM are more likely to be found in the sociology of ideas, than in the economic-financial theory of asset pricing, and in the empirical verification of asset pricing models.

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1 Eugene F Fama and Kenneth R French (2004). "The Capital Assets Pricing Model: Theory and Evidence", Journal of Economic Perspectives, 18(3): page 44.

2 John Kay and Mervyn King (2020), *Radical Uncertainty*, London: The Bridge Street Press, page 309.

3 Erol Akcay and David Hirschleifer (2020), "Social Transmission Bias and Cultural Evolution in Financial Markets", National Bureau of Economic Research working paper w27745, August 2020, page 6.

Applying the CAPM: the dividend growth model and beta estimation

The CAPM can be written:

$E(r_i) = r_f + \beta_i [E(r_m) - r_f)$,

where $E(r_i)$ is the expected rate of return on asset i when asset prices are in equilibrium, r_f is the rate of return on the risk free asset, and $E(r_m)$ is the expected rate of return on the market portfolio (the sum of all agents' portfolios).[4]

The CAPM explains the expected rate of return on asset i in terms of a risk free rate of return plus a premium for risk. This premium for risk is the product of the asset's ex ante beta (β_i) and the premium for risk in the return on the market portfolio. β_i is a standardised covariance of the return on asset i with the return on the market portfolio. It measures the riskiness of asset i arising from market risk relative to the market as a whole.

The inputs required for application of the CAPM are, then, the expected return on the market, the current risk free rate and the current beta. However, as Professors Partington and Satchell note, none of these three inputs can be directly observed. There is no asset that is completely free of risk, and no way to observe the ex ante beta. We would add: there is also no way to observe the one period ahead expected returns on the risky assets which comprise the market portfolio. Partington and Satchell summarise:

For the CAPM, the key problem is that we are modelling equilibrium expectations. Expectations cannot be observed, and neither can the inputs to the CAPM.[5]

In these circumstances, application of the CAPM typically uses parameter estimates made from past data, assuming that the future will reflect the past. However:

The future is unlikely to exactly reflect the past, but it is often the best we can do given the data available. As Mark twain is reputed to have put it, history does not repeat itself, but it does rhyme. The problem of using estimates based on past data at times of crisis, like the current Corona virus crisis, is that structural breaks become more likely.[6]

Professors Partington and Satchell draw attention to the current Corona virus pandemic as a possible cause of a structural break which can create problems when using past data to estimate the parameters of a forward-looking model – the CAPM – to allow its application. But there is more to the Corona virus pandemic than a possible structural break in the data. The virus pandemic may not have initiated, but has certainly exacerbated, severe economic recession. How the effects of this recession will play out in asset markets remains to be seen, but history indicates that the process of adjustment is likely to be slow, spanning years rather than months.

Not only are general economic conditions far from "usual". As discussed in some detail in the Australian Pipeline and Gas Association submission on alternative return on equity models, a submission to which APA contributed, transition to an economy based on a decarbonised energy sector is progressing. As this transition proceeds, lower cost renewables generation is expected to replace gas fired generation, and electricity generated from renewable sources is expected to

4 Partington and Satchell, *Alternative asset pricing models*, page 15.

5 Partington and Satchell, *Alternative asset pricing models*, page 20.

6 Partington and Satchell, *Alternative asset pricing models*, pages 20-21.

displace energy from fossil fuels including natural gas. Development of the technologies required for economy-wide use of hydrogen as a fuel is now a key focus of governments and industry. At present, however, there is uncertainty about both the timing and scale of the effects on the pipeline sector.

In these circumstances, when the economy is unlikely to be in equilibrium, does it make sense to apply an equilibrium asset pricing model even if its parameters can be estimated? If it might, when? What will be the persistence of the Corona virus, and how many years might adjustment back to equilibrium take? Even if the return to a "new normal" is relatively rapid, how relevant, if at all, will past data be to estimating the parameters of a forward looking asset pricing model like the CAPM? These are difficult questions which must be answered before the CAPM can be applied.

One specific alternative to the use of obsolete past data is use of the dividend growth model. The dividend growth model is inherently forward-looking. We doubt whether the dividend growth model is suitable for the direct estimation of rates of return on regulated electricity network and gas pipeline service providers; we doubt whether it is an alternative to the CAPM. However, it is one of a small number of ways of estimating a forward-looking expected return on the market at a time when past data are unlikely to provide a satisfactory estimate of that parameter. We acknowledge the problems of model implementation which have been identified, but are of the view that they are minor in comparison to the problems of now implementing the CAPM. The dividend growth model, has an important role to play, not as an alternative to the CAPM, but as a companion to it.

Estimates of realised betas have been used to inform beta estimation for the current rate of return instrument. If they are to continue to inform the estimation of the ex ante beta to be used in the rate of return instrument, APA remains of the views it advanced in 2017: beta variation over time cannot be ignored, and older data cease to reflect prevailing financial market conditions. Statistical estimation of realised betas should use five years of monthly data. This will, however, have the implication that estimates made using 2022 and earlier data will be obsolete by 2026. But before setting out to estimate betas from past data, the question of how those realised betas might contribute to making estimates of ex ante betas for use in a forward-looking CAPM must be addressed.

The CAPM might play a major role in the determination of estimates of the rate of return on equity for the 2022 Rate of Return Instrument, but only after establishing the way in which the model and its implementation can lead to estimates which:

- have been arrived at on a reasonable basis
- represent the best estimates possible in the circumstances.

Use of international comparators

APA agrees with the conclusion of the equity working paper that, on balance, there continues to be a range of issues which limit the use of international comparators for rates of return. That said, there are now only three ASX-listed electricity network and gas pipeline service providers for which share price data are available for beta estimation. These three are quite disparate businesses. Their beta realised estimates will not be comparable. Using these estimates to inform estimation of ex ante betas for inclusion in the rate of return instrument, is likely to be highly subjective. Careful use of the data for electricity network and gas pipeline businesses operating in other jurisdictions may assist in overcoming the problem of the small Australian sample.

With a larger sample of businesses, consideration can be given to the issue differences in betas across different sectors (electricity transmission, gas transmission, electricity distribution, gas distribution). Although a matter for lengthy discussion in the past, that discussion largely amounted to assuming away sectoral risk differences.

Direct comparison of Australian parameter estimates with those made by regulators in jurisdictions outside Australia is problematic. As the AER notes: different regulators choose different underlying methods; judgement is applied by each regulator in a complex task which has no one right answer.

The estimation of realised betas from the share price and other data from suitable international comparators might inform beta estimates appropriate in the Australian context but, in suggesting this, we are cognisant of:

- differences in business structures across jurisdictions (for example, businesses may combine network service provision and retailing)
- differences in the regulation of businesses, including, but not limited to, the regulation of network service providers
- differences in the classes of business with traded shares implying differences in market risk (for example, a share market dominated by manufacturing entities as compared with a share market with a substantial mining and resources sector)
- differences in stage of economic cycle (potentially important if beta and the market risk premium show cyclical or countercyclical behaviour).

These are all issues raised in the equity working paper. They all have implications for a further issue raised in that paper: the use of an international or "global" CAPM. While we think there are strong international linkages between financial markets, the ways in which domestic financial markets respond to domestic conditions, including domestic economic policy settings, and to particular linkages between the domestic economy and its international counterparts, is complex and unlikely to be captured by the assumptions which would have to be made for an implementable international CAPM. Some use of international comparator businesses might be useful in estimating equity returns, but APA sees no role for an international CAPM.

APA would be pleased to elaborate on any of the views in this submission. Our work on rate of return is being undertaken by [redacted] who is in our Perth office and can be contacted directly on [redacted] or at [redacted].

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Regulatory Manager

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