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Do Imputation Credits Lower the Cost of Equity? Cross-Sectional Tests

A report for United Energy

April 2015

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Executive Summary

This report has been prepared for United Energy by NERA Economic Consulting (NERA). United Energy has asked NERA to provide and review evidence on the value that the market places on imputation credits distributed. In particular, United Energy has asked NERA to:

- explain the methodology of Lajbcygier and Wheatley (2012) and of Siau, Sault and Warren (2015); [1]
- explain whether the results of these studies would be affected by higher-than-average trading volumes around ex-dividend dates;
- set out the advantages of the methodologies employed by Lajbcygier and Wheatley and of Siau, Sault and Warren relative to the use of aggregate ownership and tax statistics for the purposes of estimating the value of imputation credits; and
- update the results of the Lajbcygier and Wheatley and NERA (2013) studies and explain their relevance to estimating the value of imputation credits. [2]

United Energy has also asked NERA to respond to matters raised by the Australian Energy Regulator (AER) in its recently published *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015-20* and in other recent AER decisions, and to address issues that Handley (2014) and Lally (2013, 2014) raise in reports written on behalf of the AER and the Queensland Competition Authority (QCA). [3]

The National Electricity Rules require that the estimated cost of corporate income tax for a network service provider be reduced to reflect a value attached to imputation credits created. [4] Gamma represents the value that equity investors place on a one-dollar imputation credit created through the payment of company income tax and is generally estimated as the product of two elements:

- the *payout* ratio, being the proportion of created credits distributed by companies to their shareholders; and
- *theta*, the market value of distributed imputation credits as a proportion of their face value.

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1 Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, *Are imputation credits capitalised in stock prices?* Accounting and Finance, March 2015, pages 241-277.

2 NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

3 AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

Handley, J., *Advice on the value of imputation credits*, University of Melbourne, 29 September 2014.

Lally, M., *The estimation of gamma*, Victoria University of Wellington, 25 November 2013.

Lally, M., *Review of submissions to the QCA on the MRP, risk-free rate and gamma*, 12 March 2014.

4 Australian Energy Market Commission, *National Electricity Rules Version 69*, page 661.

In the AER's post tax revenue model (PTRM) the value of gamma is used to determine the proportion of the assumed company income tax that does not need to be included in a regulated firm's annual revenue requirement. The PTRM provides an allowance to a benchmark efficient entity for the costs of meeting corporate tax obligations and a higher value of gamma will imply that the model provides a lower allowance. The 'net tax allowance' is a component of the annual revenue requirement.

The AER's framework presumes that imputation credits distributed lower the without-credit cost of equity. Put another way, the AER uses a framework that presumes that the market places a higher value on a firm that distributes imputation credits than on an otherwise identical firm that distributes no credits. Lajbcygier and Wheatley (2012) test the proposition that imputation credits distributed lower the without-credit cost of equity while Siau, Sault and Warren (2015) test the proposition that the market places a higher value on a firm that distributes imputation credits than on an otherwise identical firm that distributes no credits. [5]

Imputation credits are of some use to domestic investors but are of little or no use to foreign investors. So the value that the market places on imputation credits distributed will largely depend on the impact that foreign investors have on equity prices.

Theory

The AER, in its *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015-20*, relies on Officer (1994) for an interpretation of what is meant by the value of imputation credits. [6] The AER, for example, states that: [7]

> 'Our approach to interpreting and estimating the value of imputation credits is guided in the first instance by the conceptual framework developed by Officer.'

While Professor Robert Officer of the University of Melbourne is a natural authority to whom to turn, extracting an interpretation from his 1994 paper is complicated by the fact that in that paper he defines gamma to be two quantities that will in general differ. In his 1994 paper, Officer defines gamma to be both:

- the proportion of credits created that are redeemed; and
- the value of a dollar of tax credits created to a representative shareholder.

We show that gamma should be interpreted as the value of a one-dollar credit to a representative investor and that this quantity can fall far below the proportion of credits created that are redeemed or the proportion of domestic equity owned by domestic residents.

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5 Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

6 Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, pages 1-17.

7 AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014, page 34.

Thus an estimate of the proportion of credits created that are redeemed is unlikely to provide an unbiased estimate of the value of a dollar of tax credits created to a representative shareholder. Similarly, an estimate of the proportion of domestic equity held by domestic residents is unlikely to provide an unbiased estimate of the value of a dollar of tax credits created to a representative shareholder.

Officer's asset pricing model, a version of the Sharpe-Lintner Capital Asset Pricing Model (CAPM), which the AER uses to compute the cost of equity for a regulated energy utility, makes two predictions:

- the cost of equity for a firm, inclusive of a value assigned to imputation credits, will be a positive linear function of its beta; and
- if the market places a value on credits distributed, then there will be a negative relation, holding beta constant, between the cost of equity for a firm, exclusive of a value assigned to credits, and the firm's credit yield.

To understand this second prediction, note that investors may receive returns in the form of capital gains, in the form of dividends and in the form of imputation credits. If an investor values credits, he or she will be willing to trade off capital gains and dividends for credits. So if the market places a value on imputation credits, then one should see a negative relation, holding risk constant, between mean returns, exclusive of credits, and credit yields. We test for a relation of this kind.

Imputation Credits and Equity Returns

In particular, we update the results of Lajbcygier and Wheatley (2012) using data for individual equities and for portfolios formed on the basis of past credit yields from July 1987 to December 2013. [8] We use three different pricing models: Officer's model and versions of the Black CAPM and Fama-French three-factor model that allow the market to place a value on imputation credits. [9] We find, like Lajbcygier and Wheatley, that:

- there is a positive, rather than a negative relation, holding a firm's equity beta or betas constant, between the firm's without-credit cost of equity and its credit yield; and
- there is no evidence that the July 2000 change to the imputation system led to a significant increase in the value of a one-dollar credit – in contrast, the evidence typically points to a decline in the value rather than the increase that the reported rise in the fraction of credits redeemed after the change might suggest.

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[8] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

[9] Black, Fischer, *Capital market equilibrium with restricted borrowing*, Journal of Business 45, 1972, pages 444-454.

Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

Thus we conclude that the evidence on the relation between returns, exclusive of credits, and credit yields, holding risk constant, suggests that theta and gamma be set to zero.

Imputation Credits and Equity Prices

An alternative way of determining whether the market places a value on imputation credits is to examine whether equity prices reflect the discounted value of the credits that firms are expected to distribute. Siau, Sault and Warren (2015) use this alternative approach. [10] In particular, they employ two methods.

First, Siau, Sault and Warren (2015) use discounted cash flow valuation models to examine the relation between equity prices and the present values of the dividends and imputation credits that firms are expected to distribute. [11] Second, they regress earnings yields on credit yields and a range of control variables. If imputation credits are capitalised into equity prices, then, all else constant, earnings yields will be negatively related to credit yields.

Siau, Sault and Warren (2015) use a sample of 468 publicly listed equities and data from 1996 to 2011 and find that: [12]

- on balance, no substantial evidence exists that imputation credits have a significant impact on equity prices; and
- earnings yields, all else constant, are positively, not negatively, related to credit yields – that is, the relation between earnings yields and credit yields is the opposite of what one would expect to find were credits capitalised into equity prices.

Siau, Sault and Warren (2015) conclude that: [13]

> 'For cost of capital estimation, arguably it is the returns expected by long-term investors that are of most consequence in setting the hurdle rate for companies to achieve. If imputation credits are not priced and hence do not influence expected buy-and-hold returns, then it may be more appropriate for them to be excluded when estimating the cost of capital. This would imply setting so-called $\theta = 0$ under the commonly used imputation adjusted CAPM.'

[10] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[11] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[12] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[13] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 244.

Relation to Drop-Off Studies

Drop-off studies typically provide estimates of theta that are positive and significant. For example, SFG (2015) provide an estimate of theta computed from a drop-off study of 0.35. [14] As Lajbcygier and Wheatley (2012), however, point out: [15]

> 'If, for example, transaction costs discourage foreign investors from engaging in ex-day strategies more than they discourage domestic investors, but transaction costs have little impact on the long-term investment plans of foreign investors, then estimates of the value that investors place on imputation credits, derived from ex-day studies, can overestimate the value that a long-term investor places on the credits.'

Similarly, SFG (2014) states about the impact of short-term traders on estimates of theta drawn from drop-off studies that: [16]

> 'To the extent that this effect is material, it results in the dividend drop-off being higher than it would otherwise be, which in turn results in the estimate of theta being higher than it would otherwise be.
>
> That is, to the extent that the increase in trading volume around the ex-dividend date has an effect, it is likely to result in an over-estimate of theta.'

The evidence that we provide and that Siau, Sault and Warren (2015) provide is consistent with this idea. Many of the estimates of theta that we produce sit significantly below 0.35. [17] Thus our evidence supports the conclusion of SFG (2015) that: [18]

> 'I remain of the view that 0.35 is a conservative estimate of the market value of distributed imputation credits.'

Neither the tests that Lajbcygier and Wheatley (2012) conduct and we update nor the tests that Siau, Sault and Warren (2015) conduct are affected in any way by higher-than-average trading volumes around ex-dividend dates. [19]

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[14] SFG, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy;* February 2015, page 4.

[15] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 478.

[16] SFG, *An appropriate regulatory estimate of gamma: Report for Jemena Gas Networks, ActewAGL, APA, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), ENERGEX, Ergon, Transend, TransGrid and SA Power Networks*, 21 May 2014, pages 31-32.

[17] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[18] SFG, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy;* February 2015, page 4.

[19] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Issues Raised by the AER and its Advisors

The AER and its advisor Lally raise a number of issues about an earlier 2013 update that we executed of the work of Lajbcygier and Wheatley (2012). [20]

We note, by way of background, that the AER and its advisor Handley have stated that they endorse the use of yield studies like those that Allen and Michaely (2003) cite in determining whether cash dividends should be fully valued when using the CAPM to estimate the cost of equity. [21] It would be reasonable to assume, therefore, that the AER and Handley would endorse the use of a similarly constructed study, like the current study, that examines whether imputation credits distributed should be assigned a value when using the CAPM to estimate the cost of equity.

Our empirical work, like the empirical work of Lajbcygier and Wheatley (2012), uses the method of Fama and MacBeth (1973). [22] Among the papers that Allen and Michaely (2003) cite prominently are papers authored by Litzenberger and Ramaswamy (1979), Miller and Scholes (1982) and Kalay and Michaely (2000) and all these authors use the method of Fama and MacBeth – either in its original form or using the modification that Litzenberger and Ramaswamy suggest that one employ. [23]

With this as background, we note that Lally (2013) states that: [24]

> 'the NERA (2013b, section 3) results are completely implausible, with an estimated utilisation rate (-2.00) that is not only negative and statistically significant but economically huge. Imputation credits might have low value but their value cannot be negative. This raises the question of whether the NERA result is an artefact of the methodology, erroneous estimates of variables such as betas, or simply data input errors. To place the issue in context, this result would be akin to

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Siau, K-W., S. Sault and G.J. Warren, *Are imputation credits capitalised in stock prices?* Working paper, ANU, June 2013.

[20] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[21] Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

[22] Fama, E. F. and J. D. Macbeth, *Risk, return and equilibrium: Empirical tests*, Journal of Political Economy, 1973, pages 607-636.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 478.

[23] Fama won the Nobel Prize in 2013, Miller in 1990 and Scholes in 1997.

Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

Kalay, A. and R. Michaely, *Dividends and taxes: A reexamination*, Financial Management 29, 2000, pages 55-75.

Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

Miller, Merton and Myron Scholes, *Dividends and taxes: Empirical evidence*, Journal of Political Economy 90, 1982, pages 1118-1141.

[24] Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

> conducting a dividend drop-off study and finding that the drop off ratio for unfranked dividends was -2.00, i.e., share prices on average rise on ex-day rather than fall, the average rise is twice that of the dividend, and the rise is statistically significant. Results from such a study could not be treated seriously, except to highlight the fragility in the methodology, and the same applies to the NERA results.'

The AER reports that NERA estimates theta to be between -1.57 and -1.90 and states in its 2013 guideline that: [25]

> 'We consider the large negative results from the NERA equity returns study are implausible, and indicate this study is not reliable. This accords with Lally's advice in his expert report.'

The AER and Lally raise a number of issues and we consider each in turn.

First, the AER (2013) and Lally (2013) charge that the results that Lajbcygier and Wheatley (2012) and NERA (2013) report are implausible. [26] We make the following points:

a. The tests that Lajbcygier and Wheatley (2012) and NERA (2013) conduct are *joint* tests of a pricing model and of the proposition that theta is nonnegative. [27] So while theta the parameter cannot be negative, an estimate of theta produced using their tests can be negative if there is something wrong with the pricing model that is being tested.

   The statistically significant estimates of -1.57, -1.90 and -2.00 that the AER (2013) and Lally (2013) report that NERA (2013) finds are constructed using Officer's CAPM – a version of the Sharpe-Lintner CAPM that allows a representative investor to place a value on distributed credits. [28] This is the model that the AER uses in setting a cost of equity for a regulated energy utility. Again, theta the parameter cannot be negative. Thus, unless it can be shown that there is something wrong with

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[25] AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

[26] AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[27] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[28] AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

the work of Lajbcygier and Wheatley (2012) and NERA, what is implausible is the idea that the Sharpe-Lintner CAPM works. [29]

What the AER (2013) and Lally (2013) do not say is that estimates of theta produced by Lajbcygier and Wheatley (2012) and NERA (2013) that employ the Black CAPM – a model which we have urged the AER elsewhere to use – do not differ significantly from zero. [30]

b. The AER (2014) states more broadly that: [31]

> 'The limitations of implied market value studies include:
>
> - These studies can produce nonsensical estimates of the utilisation rate; that is, greater than one or less than zero.'

This statement suggests that the AER has strong prior beliefs about the value of theta and is not open to the idea that theta may be approximately zero. In other words, the statement suggests that the AER is not entirely willing for the data to direct its choice of a value for theta. To see this, note that if theta the parameter is zero, then the mean of an unbiased estimator for theta will be zero. If, however, the estimator is symmetrically distributed, then on average one half of the estimates produced using the estimator will be negative and will be deemed to be 'nonsensical' by the AER. An unwillingness to consider *estimates* of theta that are negative implies that the AER is unwilling to contemplate the idea that theta the parameter may be close to zero.

Second, Lally (2013) asserts that there may be something wrong with the methodology that NERA uses. [32] We note simply that:

a. The AER (2009) and its advisor Handley (2010) have endorsed the use of yield studies like those that Allen and Michaely (2003) cite in determining whether cash dividends should be fully valued when employing the CAPM to estimate the cost of equity and the work of Lajbcygier and Wheatley (2012) and NERA (2013) uses a

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[29] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

[30] AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

[31] AER; *Draft decision for Jemena Gas Networks (NSW) Ltd Access Arrangements 2015-20, Attachment 4 – Value of imputation credits;* November 2014 (pdf version).

[32] Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

methodology that almost exactly matches the methodology that these yield studies employ. [33]

b. Past President of the American Finance Association Professor John Campbell of Harvard University has described, as recently as last year, the Fama-MacBeth method that we use as: [34]

> 'brilliantly simple'

Third, Lally (2013) asserts that the estimates of beta that NERA computes may be erroneous. [35] We note that:

a. NERA computes estimates of beta using ordinary least squares in exactly the same way as the yield studies that Allen and Michaely (2003) review and whose results the AER (2009) uses in choosing a model with which to estimate the cost of equity. [36]

b. The AER (2014) relies in large part on estimates of beta computed by Henry (2014) using ordinary least squares. [37]

Finally, Lally (2013) asserts that NERA may have made data entry errors. [38] We note that:

a. What Lally (2013) does not say is that Siau, Sault and Warren (2013) have independently verified the results of Lajbcygier and Wheatley (2012) – which are themselves very similar to the results of NERA (2013). [39] Siau, Sault and Warren state that: [40]

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[33] AER, *Final decision: Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, May 2009, page 465.

Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

Handley, J., *On the estimation of gamma*, University of Melbourne, 19 March 2010, pages 24-25.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[34] John Campbell was President of the American Finance Association in 2005.

Campbell, J.Y., *Empirical asset pricing: Eugene Fama, Lars Peter Hansen, and Robert Shiller*, Scandinavian Journal of Economics, 2014, forthcoming.

[35] Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

[36] AER, *Final decision: Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, May 2009, page 465.

Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

[37] AER, *Draft decision for Jemena Gas Networks (NSW) Ltd Access Arrangements 2015-20, Attachment 3 – Rate of return*, November 2014, page 267.

Henry, O., *Estimating β: An update*, April 2014.

[38] Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

[39] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

> 'We took the opportunity to re-investigate the relation between returns and imputation credits under both the CAPM and 3-factor model of Fama and French (1993), including using 6-monthly returns to span dividend events. The results were similar to Lajbcygier and Wheatley (2012), thus confirming their findings.'

b. NERA (2013) does not enter any data but instead relies on data provided by SIRCA, Ken French and the Reserve Bank of Australia. [41]

We conclude that Lally's (2013) comments amount to nothing more than speculation. [42]

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Australian National University, 18 June 2013, page 10.

[40] This statement also appears in the published version of their paper.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Australian National University, 18 June 2013, page 10.

[41] NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[42] Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

1. Introduction

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- explain the methodology of Lajbcygier and Wheatley (2012) and of Siau, Sault and Warren (2015); [43]
- explain whether the results of these studies would be affected by higher-than-average trading volumes around ex-dividend dates;
- set out the advantages of the methodologies employed by Lajbcygier and Wheatley and of Siau, Sault and Warren relative to the use of aggregate ownership and tax statistics for the purposes of estimating the value of imputation credits; and
- update the results of the Lajbcygier and Wheatley and NERA (2013) studies and explain their relevance to estimating the value of imputation credits. [44]

United Energy has also asked NERA to respond to matters raised by the Australian Energy Regulator (AER) in its recently published *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015-20* and in other recent AER decisions, and to address issues that Handley (2014) and Lally (2013, 2014) raise in reports written on behalf of the AER and the Queensland Competition Authority (QCA). [45]

The remainder of this report is structured as follows:

- section 2 describes the framework that the AER uses in determining a rate of return for a regulated utility and the role that imputation credits play in the framework;
- section 3 describes the methodology that Lajbcygier and Wheatley (2012) use and provides an update of the results that they and NERA (2013) supply; [46]
- section 4 describes the methodology that Siau, Sault and Warren (2015) use and the results that they provide; [47] and

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[43] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, *Are imputation credits capitalised in stock prices?* Accounting and Finance, March 2015, pages 241-277.

[44] NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[45] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

Handley, J., *Advice on the value of imputation credits*, University of Melbourne, 29 September 2014.

Lally, M., *The estimation of gamma*, Victoria University of Wellington, 25 November 2013.

Lally, M., *Review of submissions to the QCA on the MRP, risk-free rate and gamma*, 12 March 2014.

[46] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[47] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

- section 5 responds to issues that the AER (2014), Handley (2014) and Lally (2013, 2014) raise. [48]

In addition:

- Appendix A examines the relation between the redemption rate and theta, the value of a dollar of tax credits to a representative investor;
- Appendix B provides details of the estimation procedure that Lajbcygier and Wheatley (2012) and we use; [49]
- Appendix C provides the terms of reference for this report;
- Appendix D provides a copy of the Federal Court of Australia's *Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia*; and
- Appendix E provides the curriculum vitae of the author of the report.

Statement of Credentials

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

Simon Wheatley is an Affiliated Industry Expert with NERA, and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his finance expertise in investment management and consulting outside the university sector. Simon's interests and expertise are in individual portfolio choice theory, testing asset-pricing models and determining the extent to which returns are predictable. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington.

In preparing this report, the author (herein after referred to as 'I' or 'my' or 'me') confirms that I have made all the inquiries that I believe are desirable and appropriate and that no matters of significance that I regard as relevant have, to my knowledge, been withheld from this report. I acknowledge that I have read, understood and complied with the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*. I have been provided with a copy of the Federal Court of Australia's *Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia*, dated 4 June 2013, and my report has been prepared in accordance with those guidelines.

I have undertaken consultancy assignments for United Energy in the past. However, I remain at arm's length, and as an independent consultant.

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[48] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

Handley, J., *Advice on the value of imputation credits*, University of Melbourne, 29 September 2014.

Lally, M., *The estimation of gamma*, Victoria University of Wellington, 25 November 2013.

Lally, M., *Review of submissions to the QCA on the MRP, risk-free rate and gamma*, 12 March 2014.

[49] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

2. Theory

Australia has had an imputation tax system since 1 July 1987. The idea behind the system is to avoid corporate profits being taxed twice. Under a classical tax system, corporate profits are taxed at the corporate level and may be taxed again at the personal level. Under an imputation system, an imputation credit is provided to individuals or institutions for tax paid at the corporate level. Imputation credits, therefore, can alter the rate at which individuals pay taxes at the personal level. An imputation credit can be used to offset Australian tax due on the dividend to which the credit is attached or tax due on other income. Since 1 July 2000 investors have also been able to use credits to produce a rebate from the Australian Taxation Office (ATO).

In principle, imputation credits that can be used by investors to reduce the taxes that they pay at the personal level can affect the cost of equity, exclusive of a value assigned to credits, and so the values of companies. Officer (1994) use a simple perpetuity framework to examine what impact imputation credits should have on the way in which one assesses company values. He introduces a parameter he labels *gamma* and he incorporates gamma into measures of the weighted average cost of capital (*WACC*). Unfortunately, Officer defines gamma to be two quantities that will in general differ. He states that: [50]

> 'A proportion (γ) of the tax collected from the company will be rebated against personal tax and, therefore, is not really company tax but rather is a collection of personal tax at the company level.'
>
> 'γ can be interpreted as the value of a dollar of tax credits to the shareholder.'

We show that gamma should be interpreted as the value of a one-dollar credit to a representative investor and that this quantity can fall far below the proportion of tax collected that is rebated against personal tax.

The framework that the AER and other Australian regulators use is based on the perpetuity framework of Officer (1994). [51] So we begin by describing Officer's framework and the pricing model that he suggests that one can use to estimate the cost of equity.

2.1. Officer's Perpetuity Framework

Investors, besides the imputation credits that they may be able to redeem, face a wide array of taxes at the personal level on the dividends and interest that they receive. So an important question is: How should these credits and taxes affect the *WACC* formula that one should use for discounting cash flows conventionally defined? The answer is that, in a simple perpetuity framework, taxes levied at the personal level on income from equity and debt and credits distributed to equity holders will not affect the *WACC* formula that one should use. Personal taxes and credits distributed can affect the return that the market requires on equity and the

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[50] Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, page 4.

[51] Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, pages 1-17.

return that the market requires on debt, but they do not, in a perpetuity framework, affect the *WACC* formula that one should use. If personal taxes on dividends are high, the market may require that the return to equity that pays dividends be high. If personal taxes on interest are high, the market may require that the return to holding debt be high. If imputation credits can be used to reduce personal taxes, the market may accept a lower return, exclusive of a value assigned to credits, to equity that delivers credits. So taxes at the personal level and credits distributed can surely affect a company's *WACC* conventionally defined. Taxes at the personal level and credits distributed, though, will not affect the *WACC* formula that one should use for discounting cash flows conventionally defined.

As Berk and DeMarzo make clear in their corporate finance text:[52]

> 'the equity and debt cost of capital in the market *already* reflects the effects of investor taxes. As a result, *the WACC method does not change in the presence of investor taxes*.'
> [The emphasis is theirs]

Suppose that a firm is expected to deliver an operating income before taxes of X_O in perpetuity, that it has perpetual risk-free debt with market value D outstanding that will pay interest at the rate of r_D per period, that the market value of its equity is E, the cost of equity, exclusive of personal taxes or credits received, is $\mathrm{E}(r_E)$ per period, the corporate tax rate is T and the firm will follow a policy of distributing all cash flows each period.

If the firm follows a policy of maintaining a constant leverage through time, the value of the firm will be given by:

$$V = \frac{X_O - T(X_O - r_D D)}{WACC}, \tag{1}$$

where

$$WACC = \frac{D}{V} r_D + \frac{E}{V} \mathrm{E}(r_E) \tag{2}$$

In words, the value of the firm will be the after-corporate-tax net cash flows that the market expects the firm to deliver in perpetuity discounted at the firm's *WACC* conventionally defined.

Officer (1994) provides an alternative way of valuing a firm when there are credits issued that lower personal taxes.[53] He provides a definition for the cost of equity for a firm that

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[52] Berk, Jonathan and Peter DeMarzo, 2007, *Corporate finance*, Pearson Addison-Wesley, Boston, MA, USA, page 606.

[53] Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, pages 1-17.

includes a portion of the imputation credits that the firm issues. In particular, he defines the cost of equity after company tax but before personal tax to be:

$$\mathrm{E}(\hat{r}_E) = \left(\frac{1-(1-\gamma)T}{1-T} \right) \mathrm{E}(r_E) , \tag{3}$$

where γ is the parameter that Officer introduces which we will show to be the value of a one-dollar credit to a representative investor. To be clear, $\mathrm{E}(r_E)$ represents the required return on equity excluding imputation credits and $\mathrm{E}(\hat{r}_E)$ represents the required return on equity including a fraction γ of the imputation credits created and distributed.[54] Similarly, Officer defines the *WACC* after company tax but before personal tax (i.e., including a fraction γ of the imputation credits created and distributed) to be:

$$\hat{WACC} = \frac{D}{V} r_D + \frac{E}{V} \mathrm{E}(\hat{r}_E) \tag{4}$$

Officer (1994) shows that one can use this after-company-tax but before-personal-tax *WACC* to compute the value of the firm. One can do so if instead of discounting the after-corporate-tax net cash flows of $X_O - T(X_O - r_D D)$ at the *WACC* defined by (2), one discounts the after-corporate-tax but before-personal-tax net cash flows of $X_O - (1-\gamma)T(X_O - r_D D)$ at the *WACC* defined by (4). In other words, one can compute the value of the firm as:

$$V = \frac{X_O - (1-\gamma)T(X_O - r_D D)}{\hat{WACC}} \tag{5}$$

Conditional on a choice for the cost of equity exclusive of credits, $\mathrm{E}(r_E)$, the value of the firm one derives by using the formula (5) will be independent of the value of gamma. This implies that Officer's framework is consistent with the conventional framework that Berk and DeMarzo (2007) describe because one can always set gamma to be zero.[55] The insertion of gamma into the numerator of (5) is *necessitated* by defining the cost of equity in such a way that it too depends on gamma.

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[54] Note that Officer assumes that a firm is expected to deliver an operating income before taxes of X_O in perpetuity. If instead the operating income before taxes that a firm is expected to deliver will grow through time, then the expression (3) will no longer represent the required return on equity including imputation credits.

[55] Berk, Jonathan and Peter DeMarzo, 2007, Corporate Finance, Pearson Addison-Wesley, Boston, MA, USA, page 606.

2.2. Officer's Pricing Model

Officer (1994) also provides a model that one can use to estimate the cost of equity after company tax but before personal tax.[56] He assumes implicitly that risk-averse investors:

(i) choose between portfolios on the basis of the mean and variance of each portfolio's return, inclusive of a value assigned to credits received, measured over a single period;

(ii) share the same investment horizon and beliefs about the distribution of returns;

(iii) face the same rate of tax on all forms of income and no transaction costs; and

(iv) can borrow or lend freely at a single risk-free rate.

We will also assume that credits distributed by assets at the end of the period are known at the start of the period. With these assumptions, the market portfolio of all risky assets must be mean-variance efficient on a with-a portion-of-credits basis. A portfolio that is mean-variance efficient is a portfolio that has the highest mean return for a given level of risk, measured by variance of return.

If the market portfolio is mean-variance efficient on a with-a portion-of-credits basis, the following condition will hold:

$$\mathrm{E}(r_j) + \theta c_j - r_f = \beta_j(\mathrm{E}(r_m) + \theta c_m - r_f), \tag{6}$$

where:

θ = the value placed by a representative investor on a one-dollar credit;

c_j = the credit yield of asset j defined to be the ratio of the credit distributed by the asset divided by its start-of-period price;

r_f = the risk-free rate;

β_j = asset j's beta; and

c_m = the credit yield of the market portfolio.

Officer's model, which the AER uses to compute the cost of equity for a regulated energy utility, makes two predictions:

- the cost of equity for a firm, inclusive of a value assigned to imputation credits, will be a positive linear function of its beta; and
- if the market places a value on credits distributed, that is, if $\theta > 0$, then there will be a negative relation, holding beta constant, between the cost of equity for a firm, exclusive of a value assigned to credits, and the firm's credit yield. Moreover, the

[56] Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, pages 1-17.

relation will be stronger the greater is θ, that is, the value that the market places on a one-dollar credit distributed.

If asset j is the stock of the firm that Officer examines in his perpetuity framework, then $\mathrm{E}(r_j)$ will be the stock's dividend yield and its credit yield will be given by:

$$c_j = \left(\frac{T}{1-T}\right)\mathrm{E}(r_j) \tag{7}$$

Under these conditions, (6) can be rewritten as: [57]

$$\mathrm{E}(\hat{r}_j) = r_f + \beta_j(\mathrm{E}(\hat{r}_m) - r_f), \tag{8}$$

where $\gamma = \theta$ and where the relations between $\mathrm{E}(\hat{r}_j)$ and $\mathrm{E}(r_j)$ and between $\mathrm{E}(\hat{r}_m)$ and $\mathrm{E}(r_m)$ are as given by (3).

Thus Officer's plan is to use the model (8) to deliver an estimate of the cost of equity after company tax but before personal tax and to use this estimate with (4) and (5) to value the firm. An alternative plan, however, will be to use (6) to deliver an estimate of the cost of equity conventionally defined and to use this estimate with the conventional formulae (1) and (2) to value the firm. This alternative method of valuing the firm will deliver an identical result.

Again, Officer's model implies that if $\theta > 0$, then there will be a negative relation, holding beta constant, between the cost of equity for a firm, exclusive of a value assigned to credits, and the firm's credit yield. To see that this prediction must hold, consider the following simple example. Let there be two firms, A and B. Suppose that A distributes credits but B, for some unspecified reason, never distributes credits. Assume that the two firms are, however, otherwise identical. Then if Officer's model is true, it must be the case from (8) that, in equilibrium, the costs of equity for the two firms, inclusive of a value assigned to imputation credits, are equal. That is, it must be the case that:

$$\mathrm{E}(\hat{r}_A) = \mathrm{E}(\hat{r}_B) \tag{9}$$

Since A distributes credits while B does not, however, it must also be the case that the cost of equity for A, exclusive of a value assigned to credits, must lie below the cost of equity for B, exclusive of a value assigned to credits. That is, it must also be true that:

$$\mathrm{E}(r_A) < \mathrm{E}(r_B) \tag{10}$$

Moreover, the difference between the cost of equity for A, exclusive of a value assigned to credits, and the cost of equity for B, exclusive of a value assigned to credits will be greater the larger is theta. In simple terms, holding the with-credit required return on equity constant,

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[57] Note that the left-hand side of (8) will in general only match the right-hand side of (3) for a firm whose operating income before taxes is a perpetuity.

a greater return from imputation credits means that the balance of the required return will be lower.

Lajbcygier and Wheatley (2012) and NERA (2013) test the proposition that there will be a negative relation, all else constant, between the cost of equity for a firm, exclusive of a value assigned to credits, and the firm's credit yield and we update their results. [58] The tests that Lajbcygier and Wheatley and NERA conduct and that we update are *not* affected in any way by higher-than-average trading volumes around ex-dividend dates.

2.3. The Value of Imputation Credits

If the cost of equity, exclusive of a value assigned to credits, for a firm that distributes credits lies below the cost of equity, exclusive of a value assigned to credits, for a firm that distributes no credits, then distributing credits must add value to the firm. To see this, assume once more that there are two firms, A and B. Assume also that A distributes credits but B does not. Finally, assume that the two firms are otherwise identical, perpetual and, for simplicity, unlevered.

In equilibrium, the cost of equity for A, inclusive of a value for credits, must match the cost of equity for B, inclusive of a value for credits. B, however, distributes no credits, so from (3), it must be the case that:

$$\mathrm{E}(r_B) = \mathrm{E}(\hat{r}_B) = \mathrm{E}(\hat{r}_A) = \left(\frac{1-(1-\gamma)T}{1-T}\right)\mathrm{E}(r_A) \tag{11}$$

It follows, from (1), that the value of firm A will be:

$$V_A = \frac{X_O(1-T)}{\mathrm{E}(r_A)} = \frac{X_O(1-(1-\gamma)T)}{\mathrm{E}(r_B)} = V_B + \frac{\gamma TX_O}{\mathrm{E}(r_B)} > V_B\,, \tag{12}$$

where V_B is the value of firm B. Thus the value of the imputation credits that A will provide will be:

$$\frac{\gamma TX_O}{\mathrm{E}(r_B)} = \frac{\gamma TX_O}{\mathrm{E}(\hat{r}_A)} \tag{13}$$

In words, the value of the imputation credits that A will provide is the value of the credits that A will deliver each period in perpetuity discounted at A's with-credit cost of equity. Siau, Sault and Warren (2015) conduct tests of the proposition that equity prices reflect the discounted value of the credits that firms are expected to distribute. [59] The tests that Siau, Sault and Warren conduct are also *not* affected in any way by higher-than-average trading volumes around ex-dividend dates.

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[58] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[59] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

2.4. Equity Ownership Rates and Taxation Statistics

The AER bases estimates of the value of imputation credits distributed in large part on estimates of the fraction of the value of domestic equity owned by domestic investors and on estimates of the fraction of imputation credits redeemed computed from tax statistics.[60] We briefly examine here some of the problems associated with the use of ownership rates and tax statistics to estimate theta. We assume in what follows that there are two countries and that aside from an inability of foreign investors to redeem imputation credits, there are no other barriers to international investment.

The question that a regulator must answer is what impact the distribution of credits by a company will have on the cost of equity, exclusive of credits, that a benchmark efficient entity faces. To answer this question requires one compare the cost of equity that will prevail when credits are distributed to the cost of equity that would prevail were no credits to be distributed. Another way of saying the same thing is that to answer the question, one must determine what discount a domestic investor would need to accept to persuade a foreign investor to buy from the domestic investor a share of domestic equity were the share of equity to cease distributing credits. Intuition suggests that if there are a very large number of foreign investors whose characteristics do not differ markedly from domestic investors – aside from an inability to redeem imputation credits – the discount needed will be very small. Appendix A provides a simple version of Officer's model that demonstrates that this intuition is correct. If the number of foreign investors is large relative to the number of domestic investors, the impact of imputation credits on the cost of equity will be very small. In other words, if the number of foreign investors is large relative to the number of domestic investors, then theta will be a very small number. In the model described in Appendix A, theta will be the fraction of investors that are domestic.

A second question a regulator must answer is how badly the use of ownership rates and redemption rates to estimate theta will mislead. We show in Appendix A that, consistent with intuition, ownership and redemption rates will sit furthest from theta when the benefits to foreign investors of holding domestic equity are small. When the benefits are small, foreign investors will be content to allow domestic investors to hold the lion's share of domestic equity and so ownership and redemption rates will be high. Also consistent with intuition, however, theta will not be affected by the benefits that foreign investors see in holding domestic equity. Theta, instead, will be determined solely by the fraction of investors able to redeem credits. Appendix A provides a numerical example to show that even when theta is small the rate at which domestic investors own domestic equity and the rate at which credits are redeemed can be high.

To summarise, the use of ownership rates and redemption rates will not provide a reliable guide as to the value of imputation credits distributed, that is, theta. Potential holders of domestic equities – typically, foreign investors – can play an important role in determining what impact the distribution of credits will have on the cost of equity and ownership rates and redemption rates do not reflect this role.

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[60] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

3. Imputation Credits and Equity Returns

The AER's framework presumes that imputation credits distributed lower the without-credit cost of equity. Lajbcygier and Wheatley (2012) and NERA (2013) test this proposition and in this section we update the results of their tests. [61]

Lajbcygier and Wheatley (2012) use data for individual equities and for portfolios formed on the basis of past credit yields from July 1987 to December 2009. [62] They also use a number of different asset pricing models. Here, we update their results using data from July 1987 to December 2013, Officer's (1994) model and versions of the Black CAPM and Fama-French three-factor model that allow the market to place a value on imputation credits. [63, 64]

We find, like Lajbcygier and Wheatley (2012) and NERA (2013), that: [65]

- there is a positive, rather than a negative relation, holding a firm's equity beta or betas constant, between the firm's without-credit cost of equity and its credit yield; and
- there is no evidence that the July 2000 change to the imputation system led to a significant increase in the value of a one-dollar credit – in contrast, the evidence typically points to a decline in the value rather than the increase that the reported rise in the fraction of credits redeemed after the change might suggest.

Like the tests that Siau, Sault and Warren (2015) conduct, the tests that Lajbcygier and Wheatley (2012) conduct and that we update are *not* affected in any way by higher-than-average trading volumes around ex-dividend dates. [66]

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[61] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[62] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

[63] Black, Fischer, *Capital market equilibrium with restricted borrowing*, Journal of Business 45, 1972, pages 444-454.

Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, pages 1-17.

[64] All references in this report to tests of the Black CAPM, Officer CAPM or Sharpe-Lintner CAPM are to empirical versions of the models that use as a proxy for the return to the market portfolio of all risky assets the return to the market portfolio of stocks. It is an empirical version of Officer's CAPM that uses the return to the market portfolio of stocks as a proxy for the return to the market portfolio of all risky assets that the AER uses to compute an estimate of the cost of equity for a regulated energy utility.

[65] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[66] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

3.1. Methodology

We use three models to examine the relation between credit yields and equity returns. We use the Sharpe-Lintner CAPM, the Black CAPM and the Fama-French three-factor model. [67] The original versions of the models assume that imputation credits either do not exist or have no impact on the cross-section of mean returns. Officer (1994) modifies the Sharpe-Lintner CAPM to allow credits distributed to have an impact and we modify the other two models in a similar manner. [68] Also, with each model, we examine the impact on estimates of the market value of credits distributed of allowing for a tax penalty on dividends. The modified versions of the CAPM predict that the market portfolio will be after-tax mean-variance efficient, that is, it has maximum mean after-tax return for a given variance of after-tax return. The modified version of the Fama-French three-factor model predicts that the market portfolio will be after-tax multifactor efficient, that is, it has maximum mean after-tax return for a given variance of after-tax return and given betas relative to a number of factors.[69]

Like Black and Scholes (1974) and Kalay and Michaely (2000), we compute a stock's dividend yield as the sum of the dividends paid over the previous year divided by the end-of-year price of the stock and we compute the stock's credit yield in a similar manner. [70] We do not, like Litzenberger and Ramaswamy (1979), classify stocks as dividend-paying stocks only in months in which the stocks go ex-dividend. [71] We do not do so because we wish to test for a cross-sectional relation between risk-adjusted credit yields and long-run risk-adjusted returns. As Kalay and Michaely show, most of the return variation that Litzenberger and Ramaswamy attribute to dividends can be traced to time-series variation between dividend-paying months and non-dividend paying months rather than to cross-sectional variation in returns.

To estimate the parameters of each model, we, like Lajbcygier and Wheatley (2012), use the two-pass methodology of Fama and MacBeth (1973) and Litzenberger and Ramaswamy

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[67] Black, Fischer, *Capital market equilibrium with restricted borrowing*, Journal of Business 45, 1972, pages 444-454.

Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

Lintner, John, *The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets*, Review of Economics and Statistics 47, 1965, pages 13-37.

Sharpe, William F., *Capital asset prices: A theory of market equilibrium under conditions of risk*, Journal of Finance 19, 1964, pages 425-442.

[68] Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, pages 1-17.

[69] Fama (1996) explains what it means for a portfolio to be multifactor efficient.

[70] Black, F. and M. Scholes, *The effects of dividend yield and dividend policy on common stock prices and returns*, Journal of Financial Economics, 1974, pages 1-22.

Kalay, A. and R. Michaely, *Dividends and taxes: A reexamination*, Financial Management 29, 2000, pages 55-75.

[71] Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

(1979). [72] Appendix B provides a detailed description of the approach that Lajbcygier and Wheatley and we use. Here we provide only a brief outline.

In the first pass, for each stock and month least squares estimates are computed of the beta or betas that each pricing model employs using the last 60 months of data.

In the second pass, for each month and pricing model, estimates are computed of the parameters of a cross-sectional regression that relates risk-adjusted returns to risk-adjusted credit yields and, in some specifications that we use, risk-adjusted dividend yields. The output from the second pass includes a time series of estimates of the value that the market attaches to a one-dollar credit distributed and, in some specifications, a time series of estimates of the additional dollar with-dividend return that the market requires on a stock for each additional dollar of dividends paid.

To test hypotheses about the mean over time of each series of estimates we compare the sample mean of the series of estimates to its standard error computed in the usual way, that is, under the assumption that the series of estimates is independently and identically distributed over time.

There are two potential problems with the two-pass procedure. The first problem is that since the least squares estimate of the vector of betas measures the vector with error, the second-pass estimates will be biased. There are two ways of addressing this problem and we use both ways. The first way is to place stocks into portfolios, like Fama and MacBeth (1973), so as to diversify away much of the measurement error but to do so in such a manner as to retain as much of the cross-sectional variation in the second-pass regressors as possible. [73] The second way is to modify the second-pass estimator, as Litzenberger and Ramaswamy (1979) do, to take into account the errors-in-variables problem. [74]

The second problem with the two-pass procedure is that the Fama-MacBeth method of computing the standard errors attached to the second-pass estimates does not properly take into account the measurement error associated with the beta estimates. Shanken (1992) shows that if, conditional on the factors, returns are homoskedastic, Fama-MacBeth standard errors will be downwardly biased. [75] He notes, though, that for models in which the factors are portfolio returns the bias is likely to be small. Jagannathan and Wang (1998), on the

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[72] Fama, E. F. and J. D. Macbeth, *Risk, return and equilibrium: Empirical tests*, Journal of Political Economy, 1973, pages 607-636.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

[73] Fama, E. F. and J. D. Macbeth, *Risk, return and equilibrium: Empirical tests*, Journal of Political Economy, 1973, pages 607-636.

[74] Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

[75] Shanken, J., *On the estimation of beta pricing models*, Review of Financial Studies 5, 1992, pages 1-33.

other hand, show that if, conditional on the factors, returns are heteroskedastic, Fama-MacBeth standard errors can be upwardly biased. [76]

To examine the extent to which Fama-MacBeth standard errors are biased, Lajbcygier and Wheatley (2012) conduct bootstrap simulations that allow for heteroskedasticity and are calibrated to the portfolio data that they construct. [77] The simulations examine the properties of estimates that use the Sharpe-Lintner CAPM in which it is assumed there is no tax penalty associated with dividends. The results of their simulations indicate that the extent to which Fama-MacBeth standard errors mislead is negligible and that it is safe to rely on the standard errors to conduct inference. The results also show that the second pass-estimates are close to unbiased. So, like Kalay and Michaely (2000), in our empirical work, we use Fama-MacBeth standard errors and do not adjust the standard errors for the measurement error associated with the beta estimates. [78]

3.2. Data

We extract monthly returns from July 1983 to December 2013 for individual stocks and the imputation credits and dividends that the stocks deliver from SIRCA's Share Price and Price Relative Data Base (SPPR).[79, 80] We exclude foreign stocks listed in Australia and also, to minimise the impact of market microstructure effects, stocks in each year that at the end of the previous year fell outside the top 500 domestic stocks by market capitalisation.[81] Lajbcygier and Wheatley (2012) and NERA (2013) use their best efforts to remove foreign stocks. [82] In the 2013 version of the SPPR database, SIRCA introduces a flag that indicates whether a company is incorporated outside of Australia and in this report we use this flag. SIRCA notes that companies deemed to be foreign in January 1988 are assumed to have been foreign prior to that date and so a survivorship bias may be associated in work that uses the flag prior to January 1988. Since the imputation system was introduced in June 1987 and we compute yields using 12 months of data, however, we do not run our first Fama-MacBeth regression until July 1988 and so we are confident that our tests are free of any survivorship bias. From the stocks remaining after we have excluded foreign stocks and low-market capitalisation stocks, we form a number of portfolios.

First, we form a value-weighted portfolio of the 500 stocks and use the portfolio as a proxy for the Australian market portfolio. Second, we form a value-weighted portfolio of small

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[76] Jagannathan, R. and Z. Wang, *An asymptotic theory for estimating beta-pricing models using cross-sectional regression*, Journal of Finance 53, 1998, pages 1285-1309.

[77] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

[78] Kalay, A. and R. Michaely, *Dividends and taxes: A reexamination*, Financial Management 29, 2000, pages 55-75.

[79] The imputation system was introduced in July 1987 and we compute credit yields using 12 months of data and beta estimates using 60 months of data. So we extract data starting in July 1983.

[80] SIRCA Australian Share Price and Price Relative (SPPR) information supplied by RoZetta Technology Pty Ltd (www.rozettatechnology.com).

[81] We choose the top 500 because the All Ordinaries Index is constructed from the top 500 stocks.

[82] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

firms from the bottom 30 percent of firms and a value-weighted portfolio of big firms from the top 30 percent. We use the difference between the returns to these portfolios as the *SMB* (small minus big) factor in the Fama-French three-factor model and rebalance the portfolios at the end of each year. We form the *SMB* factor in this way because we take the *HML* (high minus low) factor from Ken French's web site and French constructs the *HML* factor in this way.[83]

Third, we form portfolios on the basis of credit yield. At the end of June each year we compute the credit yield for each stock as the sum of the imputation credits distributed over the previous 12 months divided by the price of the stock at the end of June, and we compute the dividend yield for each stock in a similar manner. We place stocks that paid no dividends over the 12 months and so delivered no credits in one portfolio, stocks that paid dividends but delivered no credits in another and stocks that delivered credits into five portfolios on the basis of their credit yields. So we form portfolios in a way that is similar to the manner in which Fama and French (1993) form portfolios on the basis of dividend yield – except that, like Kalay and Michaely (2000), we compute yields by dividing by end-of-financial-year price while Fama and French compute yields by dividing by start-of-financial-year price. [84] We conduct tests that use these seven portfolios but also, separately, tests that use individual stocks.[85] Thus our results do not rely solely on the behaviour of a small number of large stocks or solely on the behaviour of a large number of small stocks. We use both portfolio and individual stock data.

Finally, we extract the one-month risk-free rate from the SPPR, the returns to growth and value portfolios from Ken French's web site and the yield to a 10-year Commonwealth Government Security (CGS) from the Reserve Bank. Since we use monthly data, we use as a proxy for the risk-free rate the one-month risk-free rate taken from the SPPR. We also examine, however, the sensitivity of our results to replacing this rate with the yield on a monthly basis to a 10-year CGS.

3.3. Summary Statistics

We use three models to test whether, holding risk constant, equity returns are related to credit yields. Table 3.1 provides summary statistics computed using monthly data from July 1988 to December 2013 for the three factors that the models employ. The means of the factors, aside from the *SMB* factor, take on the same signs that others have typically found, but none of the means differs significantly from zero at conventional levels. The imprecision with

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[83] See Fama and French (1998) for a detailed description of how they construct the *HML* factors that we use.

Fama, Eugene and Kenneth French, *Value versus growth: The international evidence*, Journal of Finance 53, 1998, pages 1975–99.

[84] Fama, Eugene and Kenneth French, *Common risk factors in the returns to stocks and bonds*, Journal of Financial Economics 33, 1993, pages 3-56.

Kalay, A. and R. Michaely, *Dividends and taxes: A reexamination*, Financial Management 29, 2000, pages 55-75.

[85] To ensure that extreme values do not heavily influence tests that use individual stocks, like Fama and French (1992), we winsorise the data that we use in the tests. In particular, we shrink extreme credit and dividend yields to their 99th percentiles. We do not, on the other hand, winsorise the data that we use in tests that employ portfolios.

Fama, Eugene and Kenneth French, *The cross-section of expected returns*, Journal of Finance 47, 1992, pages 427-465.

which we estimate the factor means suggests that our tests may lack power. We find, though, in what follows that, despite this imprecision, our tests have sufficient power that we are able to reject a number of important hypotheses. Table 3.1 also shows that there are some interesting differences between the credit yields and dividend yields of value stocks and growth stocks and between the credit yields and dividend yields of large-caps and small-caps. Value stocks tend to have higher credit yields and dividend yields than growth stocks. Similarly, large-caps tend to have higher credit yields and dividend yields than small-caps.

Table 3.1
Summary statistics for the three factors

	MMF	*HML*	*SMB*
Mean	4.11	3.72	-0.48
Standard deviation	13.31	12.46	14.26
Credit yield	1.64	0.53	-0.52
Dividend yield	4.15	1.43	-1.01

Note: Estimates are computed using data from July 1988 to December 2013. Each factor is the return to a zero-investment portfolio and so returns and yields are the differences between the returns to and yields of two portfolios. The factor MMF is the difference between the return to the market portfolio and the risk-free rate. HML is the difference between the returns to portfolios of high and low book-to-market stocks and SMB is the difference between the returns to portfolios of low and high market-capitalisation stocks. All statistics are in per cent per annum. Sample means have been annualised by multiplying the monthly data by 1200 and standard deviations have been annualised by multiplying the standard deviations of the monthly data by 100 × √12.

Our tests use individual stocks and seven value-weighted portfolios formed on the basis of past credit yields. Table 3.2 provides summary statistics for the seven portfolios computed using data from July 1988 through December 2013. Portfolio 1 contains stocks that paid no dividends and so delivered no credits over the previous year, portfolio 2 contains stocks that paid dividends over the previous year but delivered no credits while portfolios 3 through 7 contain stocks that paid dividends over the previous year and delivered credits. The table shows that the mean returns in excess of the risk-free rate to portfolios 1, 2 and 3, the three portfolios containing stocks that delivered few or no credits over the previous year, are low. On the other hand, the table shows that the CAPM betas of the three portfolios computed relative to the domestic market portfolio are not, on average through time, substantially lower than the CAPM betas of the other five portfolios. Indeed, the beta of portfolio 1 is, on average, higher than the betas of the other portfolios. Thus the table suggests that a model that predicts that, holding beta constant, there should be a negative relation between mean returns and credit yields will have difficulty in explaining the data. Figure 3.1 illustrates how a model of this kind will have difficulty in explaining the data. The figure plots an estimate of the risk-adjusted mean return to each portfolio:

$$\mathrm{E}(r_j) - r_f - \beta_j(\mathrm{E}(r_m) - r_f), \tag{14}$$

computed using the data from Table 3.1 and Table 3.2, against an estimate of its risk-adjusted credit yield:

$$c_j - \beta_j c_m \tag{15}$$

The blue circles correspond to the seven portfolios while the dashed red line and solid red line show where the portfolios would plot were the data to conform to the predictions of the model and theta were to be 0.4 or 0.7 – the estimates of theta, based on ownership rates, on which the AER in large part relies. [86] The figure shows that it will be difficult to conclude that the data are consistent with the model that the AER uses – Officer's model – and estimates of theta that lie within the range on which the AER in large part it relies of 0.4 to 0.7.

Table 3.2
Summary statistics for portfolios formed on the basis of past credit yields

					CAPM	Fama-French beta		
Portfolio	Number of stocks	Credit yield	Dividend yield	Mean excess return	Beta	Market	*HML*	*SMB*
1	79.61	0.31	0.93	-0.57	1.45	1.39	-0.19	0.84
2	43.64	0.18	4.49	3.24	0.90	0.94	0.26	0.01
3	33.29	1.05	3.00	4.39	1.13	1.12	0.01	-0.02
4	33.80	1.71	3.65	5.48	1.00	0.99	-0.07	-0.08
5	33.56	2.18	4.46	6.23	0.92	0.93	0.06	-0.10
6	33.94	2.59	5.34	6.32	0.89	0.91	0.14	-0.12
7	33.25	3.30	6.45	5.95	0.81	0.81	0.08	-0.01

Note: The statistics are computed using data from July 1988 to December 2013. Portfolio 1 consists of stocks that paid no dividends in the previous year while portfolio 2 consists of stocks that paid a dividend in the previous year to which no credits were attached. Portfolios 3 through 7 consist of stocks that paid dividends to which credits were attached. The portfolios are value weighted and so all statistics, other than the average number of stocks in each portfolio in each month, are value-weighted averages. Betas are the value-weighted averages across time of estimates computed using the previous 60 months of data. Yields are in percent per annum and sample mean excess returns, which have been annualised by multiplying the means of the monthly data by 1200, are also in percent per annum.

[86] Note that SFG (2015) points out that the AER adopts a range that is above that which is supported by the data.

AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

SFG Consulting, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy*, February 2015, pages 29-31.

Table 3.2 also shows that portfolio 1 has on average a high *SMB* beta while portfolio 2 has on average an *HML* beta that is higher than most of the other portfolios. Table 3.1 indicates that the sample mean of the *SMB* factor is approximately zero while the sample mean of the *HML* factor is positive. Thus one would not expect the higher exposure to the *SMB* factor of portfolio 1 to have much impact on its return. The higher exposure to the *HML* factor of portfolio 2, on the other hand, suggests that it should have earned a higher not lower return on average over the sample period than the other portfolios. Thus the table suggests that a model that predicts that, holding the three Fama-French betas constant, there should be a negative relation between mean returns and credit yields will also have difficulty in explaining the data.

Figure 3.1
Relation between risk-adjusted excess returns and risk-adjusted credit yields

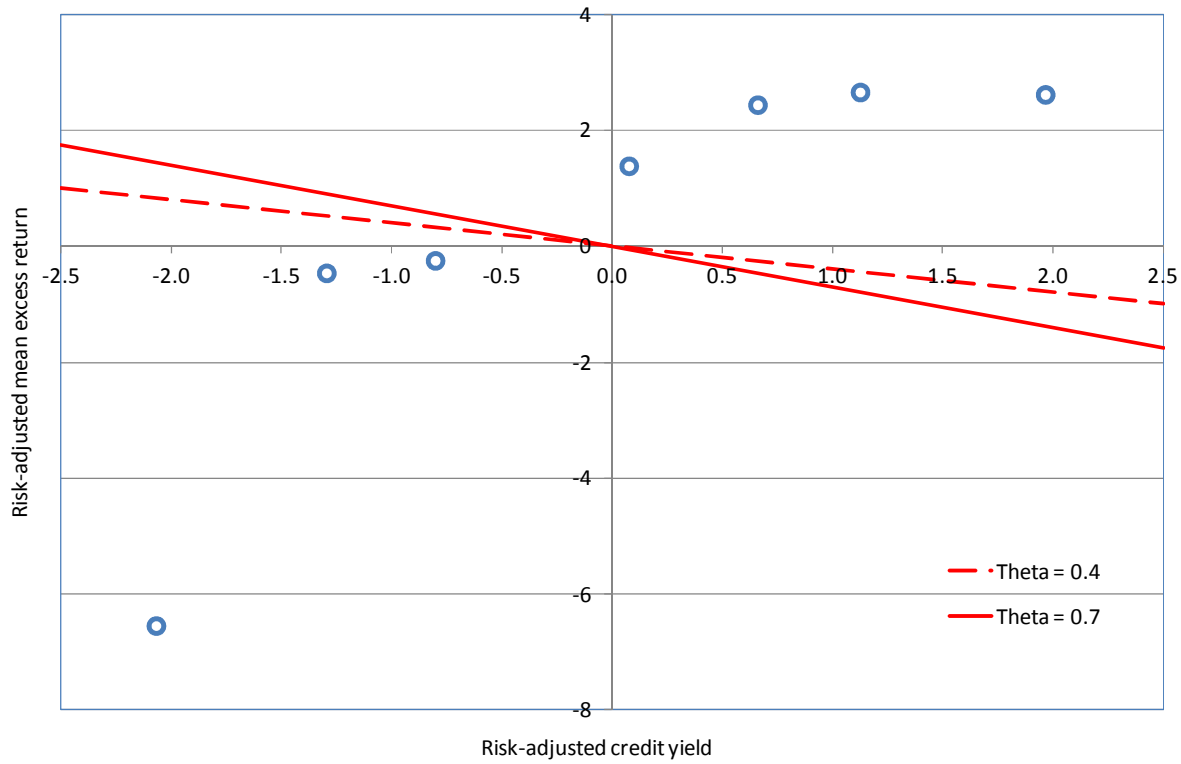
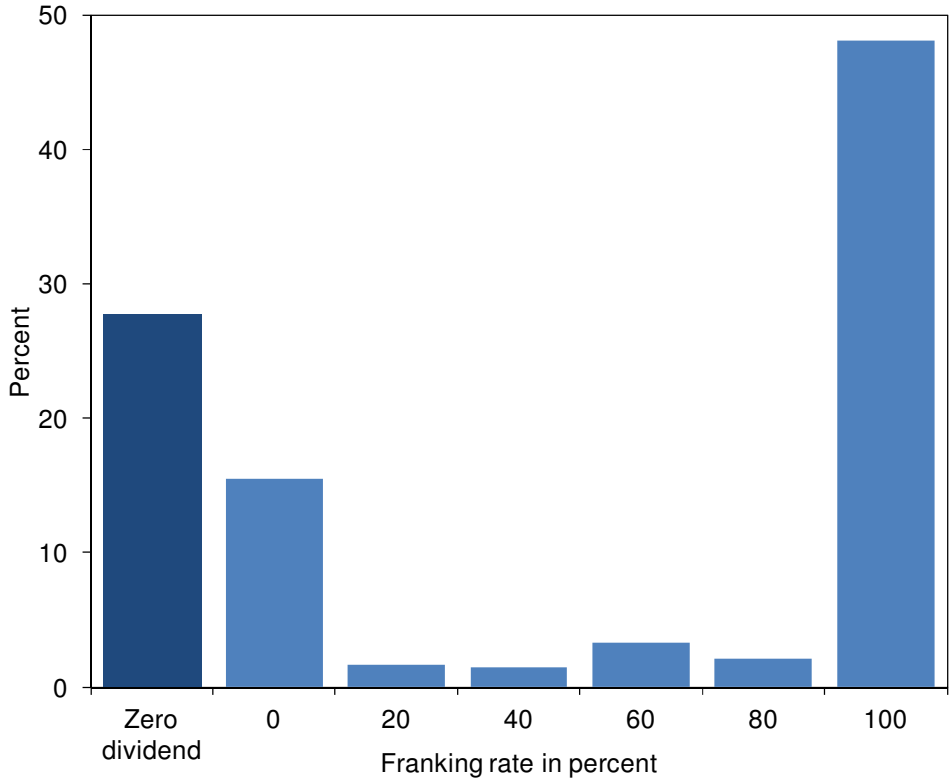


Table 3.2 indicates that stocks that have not in the recent past delivered credits are likely to play an important role in tests for a relation between equity returns and credit yields. An examination of the distribution of the rates at which dividends are franked shows that stocks that pay dividends but deliver no credits must also play an important role in drop-off studies. Figure 3.2 shows the distribution of franking rates for the top 500 stocks from 1988 to 2013. 28 percent of the stocks do not pay a dividend, 16 percent pay a dividend but do not deliver a credit, 9 percent pay partially franked dividends while 48 percent pay fully franked dividends. [87] Credit yields and dividend yields are perfectly positively correlated across stocks that pay fully franked dividends. So were drop-off studies to use solely stocks paying

[87] These percentages do not sum to 100 per cent because they are rounded.

fully franked dividends, the studies would be able to value only the package that is a one-dollar dividend and the credit attached to the dividend. The studies would be unable to value separately the dividend and credit. Drop-off studies therefore rely on stocks that do not pay fully franked dividends to determine separately the market value of a one-dollar dividend and the credit attached to the dividend.[88] As Figure 3.2 shows, 64 percent of these stocks are stocks that pay dividends but deliver no credits. [89]

Figure 3.2
Distribution of franking rates



3.4. Credit Yields and Returns

The pricing model that is used by the AER to set the cost of equity assumes that the market places a value on imputation credits but does not impose a tax penalty on dividends.[90] So we start by examining models in which, holding risk constant, equity returns may be related to credit yields but, holding credit yields also constant, they are unrelated to dividend yields. Table 3.3 provides estimates of the value that the market places on a one-dollar credit computed using the three pricing models, individual stocks and the seven portfolios formed

[88] Drop-off studies do not use stocks that do not pay dividends. In contrast, our tests use these stocks.

[89] 16 percent of stocks pay a dividend but do not deliver a credit while 9 percent of stocks deliver credits but do not pay fully franked dividends. Thus 16/(16+9) = 64 percent of stocks that are not fully franked deliver no credit.

[90] Whether there is a tax penalty on dividends will be determined by whether the tax rate that a representative investor faces on capital gains matches the rate that the investor faces on income.

on the basis of past credit yields. The estimates of the value that the market places on a one-dollar credit are uniformly negative.[91] Tests that use the Sharpe-Lintner and Fama-French models reject the null that a nonpositive relation exists between equity returns and credit yields, holding risk constant, irrespective of whether the tests use individual stocks or portfolios formed on the basis of past credit yields. On the other hand, tests of the null that use the Black model do not reject the null. An estimate of the value that the market places on a one-dollar credit distributed that uses the Black model and individual securities, which is more precise than its counterpart that uses the seven portfolios, can be used, however, to reject other hypotheses. A 95 per cent confidence interval based on the estimate will be $-0.40 \pm 1.96 \times 0.38$, that is, from -1.14 to 0.34. Thus, using the Black model, one can reject the hypothesis that theta lies in the range 0.4 to 0.7 – the range, based on ownership rates on which the AER in large part relies.[92] There is also weak evidence against the hypothesis that theta is as high as 0.35 – the estimate, based on a drop-off study, on which SFG (2015) relies.[93]

The AER uses the 10-year CGS yield as a proxy for the risk-free rate. Replacing the one-month risk-free rate with the yield on a monthly basis on a 10-year CGS has little impact on our results. For example, estimates of the value that the market places on a one-dollar credit that use the Sharpe-Lintner CAPM and portfolio and security data are -1.92 and -1.38 and the standard errors attached to the estimates are 0.80 and 0.45.

Table 3.3 also provides estimates that use the Black model of the mean excess return to a zero-beta portfolio. Since we form portfolios on the basis of past credit yields and not, in addition, on the basis of past estimates of risk, we do not expect estimates of the mean excess return to a zero-beta portfolio that use the seven portfolios to be precise.[94] Table 3.3 indicates that this expectation is borne out and so we focus on the individual stock estimate.[95] The

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[91] The value that the market places on a one-dollar credit cannot be truly negative because the receipt of a credit can never make an investor worse off.

[92] Again, note that SFG (2015) points out that the AER adopts a range that is above that which is supported by the data.

AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

SFG Consulting, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy*, February 2015, pages 29-31.

[93] SFG Consulting, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy*, February 2015, page 3.

[94] We do not sort stocks into portfolios on the basis of past credit yields and past estimates of risk because with up to three different measures of risk each portfolio would end up containing relatively few stocks.

[95] Each month the tests that use individual stocks employ around 500 stocks and there is likely to be a substantial variation in risk across these stocks. Thus it is not surprising that the estimates of the zero-beta rate and the value that investors place on a one-dollar credit that we produce using individual stocks are more precise than their portfolio counterparts. Estimates of the risks of individual stocks, however, will be imprecise and this lack of precision, as we explain above, can create an errors-in-variables problem. The modified second-pass estimator of Litzenberger and Ramaswamy (1979) that we employ is designed to take this problem into account.

estimate of the mean excess return on a zero-beta portfolio that uses individual stocks is large and positive and significant at the five percent level. The estimate of the mean excess return to a zero-beta portfolio is sufficiently large, for example, that the estimate exceeds the estimate of the mean excess return to the market portfolio that appears in Table 3.1.

Table 3.3
Estimates of the value that the market places on imputation credits

	Portfolios		Securities	
Model	Zero-beta excess return	Credit value	Zero-beta excess return	Credit value
Sharpe-Lintner		-2.16†		-1.42†
		(0.83)		(0.43)
Black	11.60	-0.57	6.27*	-0.40
	(6.96)	(0.91)	(2.05)	(0.38)
Fama-French		-1.74†		-1.27†
		(0.78)		(0.40)

*Note: Estimates of the mean excess return to a zero-beta portfolio that delivers no credits, which have been annualised by multiplying the means of the monthly data by 1200, are in percent per annum. Credit value estimates are estimates of the dollar value that the market places on a one-dollar imputation credit. Standard errors are in parentheses. * indicates significantly greater than zero at the 5 percent level. † indicates significantly less than zero at the 5 percent level.*

3.5. Credit Yields, Dividends and Returns

A potential explanation for the positive relation that we document, holding risk constant, between equity returns and credit yields is that the relation arises from an omitted variables bias. In particular, a potential explanation is that the relation arises from a positive relation, generated by the impact of taxes, between equity returns and dividend yields, holding credit yields and risk constant, and a positive relation between credit yields and dividend yields. To determine whether this explanation is consistent with the data, we test whether equity returns are related, holding risk constant, to both credit yields and dividend yields. Table 3.4 provides estimates of the additional dollar with-dividend return that the market requires for each additional dollar of dividends paid using the three pricing models, individual stocks and the seven portfolios formed on the basis of past credit yields. The estimates of the additional dollar with-dividend return that the market requires for each additional dollar of dividends paid do not differ significantly from zero. As before, tests that use the Sharpe-Lintner and Fama-French models and individual securities, reject the null that a non-positive relation exists between equity returns and credit yields, holding risk constant. Tests that use portfolios formed on the basis of past credit yields, however, do not do so and the estimates of both the dividend penalty and credit value are imprecise.

Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

Tests of the null that use the Black model do not reject irrespective of whether the tests use portfolios or individual securities. An estimate of the value that the market places on a one-dollar credit distributed that uses the Black model and individual securities, which is more precise than its counterpart that uses the seven portfolios, can be used, however, to reject other hypotheses. A 95 per cent confidence interval based on the estimate will be $-0.48 \pm 1.96 \times 0.42$, that is, from -1.30 to 0.34. Thus, using the Black model, one can reject the hypothesis that theta lies in the range 0.4 to 0.7 – the range, based on ownership rates on which the AER in large part relies. [96] There is also weak evidence against the hypothesis that theta is as high as 0.35 – the estimate, based on a drop-off study, on which SFG (2015) relies. [97]

Table 3.4
Estimates of the penalty that the market attaches to dividends and value that the market places on imputation credits

	Portfolios			Securities		
Model	Zero-beta excess return	Dividend penalty	Credit value	Zero-beta excess return	Dividend penalty	Credit value
SL		0.30	-1.76		0.22	-1.11†
		(1.05)	(1.23)		(0.23)	(0.45)
Black	0.03	-0.07	-1.27	0.40*	-0.25	-0.48
	(0.72)	(1.10)	(1.35)	(0.18)	(0.22)	(0.42)
FF		0.36	-1.73		0.17	-1.09†
		(1.01)	(1.20)		(0.21)	(0.43)

*Note: SL stands for Sharpe-Lintner while FF stands for Fama-French. Estimates of the mean excess return to a zero-beta portfolio that delivers no credits and pays no dividends, which have been annualised by multiplying the monthly excess returns by 1200, are in percent per annum. Dividend penalty estimates are estimates of the additional dollar with-dividend return that the market requires on a stock for each additional dollar of dividends paid. Credit value estimates are estimates of the dollar value that the market places on a one-dollar imputation credit. Standard errors are in parentheses. * indicates significantly greater than zero at the 5 percent level. † indicates significantly less than zero at the 5 percent level.*

[96] Again, note that SFG (2015) points out that the AER adopts a range that is above that which is supported by the data.

AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

SFG Consulting, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy*, February 2015, pages 29-31.

[97] SFG Consulting, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy*, February 2015, page 3.

3.6. Impact of Tax Regime Changes

There have been a number of changes to Australia's imputation system since its introduction in July 1987. The most recent change of July 2000 has made it easier for domestic investors to redeem imputation credits. Before July 2000, the tax rebate received by a domestic investor could not exceed the investor's tax liability. Since July 2000, however, a domestic investor has typically been able to redeem all credits received, regardless of the investor's liability. Handley and Maheswaran (2008) find that the July 2000 change had a significant impact on the fraction of credits redeemed.[98] They report that '67 per cent of distributed imputation credits were used to reduce personal taxes during 1990-2000, but this has increased to 81 per cent over 2001-2004.' Although the July 2000 change may have had an impact on the fraction of credits redeemed, however, it does not follow that the change will necessarily have had an impact on the returns required on equity. If equity markets are segmented, a change to the imputation system that raises the fraction of credits redeemed should lower the returns required on equity. If equity markets are – aside from an inability of foreign investors to redeem credits – integrated, a change to the imputation system, even though it may raise the fraction of credits redeemed, should have little impact on the returns that the market requires on equity.

To examine whether the July 2000 change had an impact on the returns that the market requires on equity, we test whether in July 2000 a structural break occurred in the relation between risk-adjusted returns and risk-adjusted credit yields. We test for a single structural break in July 2000 because tests for more than one break lack power and because of the importance that Handley and Maheswaran (2008) place on the July 2000 change to the imputation system.[99] We test for a structural break by computing an estimate of the value of a one-dollar credit distributed using data that begin in July 2000, computing an estimate using data from before July 2000 and testing whether the two estimates differ significantly.[100] The pricing model that the AER uses to set the cost of equity assumes that the market places a value on imputation credits but does not impose a tax penalty on firms that pay dividends. So we restrict our attention here to models in which, holding credit yields and risk constant, equity returns are unrelated to dividend yields.

Table 3.5 provides estimates of the value that the market places on a one-dollar credit computed using data from before July 2000 and estimates computed using data that begin in

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[98] Note, however, that Hathaway (2010) expresses strong reservations about the reliability of Handley and Maheswaran's work. For example, he points out that Handley and Maheswaran combine final recipients (individuals and funds) with pass-through investors (trusts and partnerships) ignoring the fact that many of these pass-through investors return their dividends and credits to the very companies that issued them, so double counting dividends and credits.

Hathaway, N., *Comment on: "A Measure of the Efficacy of the Australian Imputation Tax System" by John Handley and Krishan Maheswaran*; Capital Research, July 2010.

Handley, J. and K. Maheswaran, *A measure of the efficacy of the Australian imputation tax system*, Economic Record 84, 2008, pages 82-94.

[99] Handley, J. and K. Maheswaran, *A measure of the efficacy of the Australian imputation tax system*, Economic Record 84, 2008, pages 82-94.

[100] If the July 2000 change lowered the returns required on equity, an announcement of the change before July 2000 would have raised equity prices. Thus the impact of an announcement of the change before July 2000 should be to make any impact of the change on the returns required on equity easier to detect.

July 2000. Estimates of the value of a one-dollar credit computed using data either from before July 2000 or that begin in July 2000 are typically negative while, as was true in Table 3.3 and Table 3.4, estimates that use individual stocks tend to be more precise than those that use portfolios. Despite the lack of precision associated with the estimates, however, tests that use the Sharpe-Lintner and Fama-French models and data that begin in July 2000 reject the null that a nonpositive relation exists, holding risk constant, between equity returns and credit yields regardless of whether the tests use portfolios or individual securities.

Table 3.5 also provides estimates of the difference between the value of a one-dollar credit from July 2000 onwards and the value before July 2000. These estimates provide no evidence that the July 2000 change to the imputation system led to a significant increase in the value of a one-dollar credit. In contrast, the estimates point to a decline in the value rather than the increase that the reported rise in the fraction of credits redeemed after the change might suggest.

Table 3.5
Stability of estimates of the value that the market places on imputation credits

	Credit value estimates					
	Portfolios			Securities		
Model	Before July 2000	July 2000 – December 2013	Difference	Before July 2000	July 2000 – December 2013	Difference
Sharpe-Lintner	-0.90	-3.18†	-2.28	-0.38	-2.34†	-1.96†
	(1.06)	(1.24)	(1.63)	(0.49)	(0.67)	(0.83)
Black	-0.02	-1.02	-1.00	0.20	-0.94	-1.14
	(1.22)	(1.33)	(1.80)	(0.47)	(0.59)	(0.75)
Fama-French	-0.19	-3.00†	-2.81†	-0.23	-2.20†	-1.97†
	(1.07)	(1.12)	(1.54)	(0.50)	(0.60)	(0.78)

Note: Credit value estimates are estimates of the dollar value that the market places on a one-dollar imputation credit. Standard errors are in parentheses. The significance of the difference between estimates computed using data from July 2000 to December 2013 and estimates computed using data from before July 2000 is determined using the Smith-Satterthwaite test described by Miller and Freund (1965).[101] *† indicates significantly less than zero at the 5 percent level.*

[101] Miller, I. and J. E. Freund, *Probability and statistics for engineers*, Prentice-Hall, Englewood Cliffs, NJ, 1965.

4. Imputation Credits and Equity Prices

The AER's framework presumes that the market places a higher value on a firm that distributes imputation credits than on an otherwise identical firm that distributes no credits. Siau, Sault and Warren (2015) test this proposition and in this section we review the results of their tests. [102] They employ two methods. First, they use discounted cash flow valuation models to examine the relation between equity prices and the present values of the dividends and imputation credits that firms are expected to distribute. Second, they regress earnings yields on credit yields and a range of control variables. If imputation credits are capitalised into equity prices, then, all else constant, earnings yields should be negatively related to credit yields.

Siau, Sault and Warren (2015) use a sample of 468 publicly listed equities and data from 1996 to 2011 and find that: [103]

- on balance, no substantial evidence exists that imputation credits have a significant impact on equity prices; and
- earnings yields, all else constant, are positively, not negatively, related to credit yields – that is, the relation between earnings yields and credit yields is the opposite of what one would expect to find were credits to be capitalised into equity prices.

Like the tests that Lajbcygier and Wheatley (2012) conduct, the tests that Siau, Sault and Warren (2015) conduct are *not* affected in any way by higher-than-average trading volumes around ex-dividend dates. [104]

4.1. Methodology

4.1.1. Valuation models

To examine the relation between equity prices and the present values of the dividends and imputation credits that firms are expected to distribute, Siau, Sault and Warren (2015) first compute estimates of these present values. [105] They estimate the present value of the dividends that a share is expected to deliver as the sum of:

- the discounted value of the dividends analysts forecast will be paid over the remainder of the current fiscal year on the share;

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[102] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[103] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[104] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[105] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

- the discounted value of the dividends analysts forecast will be paid over the next fiscal year on the share; and
- the discounted value of the earnings analysts forecast will be paid over the year following the next fiscal year on the share, capitalised at the real cost of equity.

Thus Siau, Sault and Warren assume from the year following the next fiscal year that:

- a good proxy for dividends per share is earnings per share; and
- earnings per share are forecast to grow at the forecast rate of inflation, which they set at 2.5 per cent per annum.

Siau, Sault and Warren (2015) estimate the present value of the imputation credits that a share is expected to deliver as the product of the present value of dividends and the current credits delivered per dollar of dividends distributed. [106] Armed with estimates of the present values of the dividends and imputation credits that firms are expected to distribute, Siau, Sault and Warren (2015) run the following regression: [107]

$$P_{jt} = \alpha + \beta PVD_{jt} + \gamma PVC_{jt} + \varepsilon_{jt} \quad (16)$$

where P_{jt} is the price of equity j at time t, PVD_{jt} is an estimate at time t of the present value of the dividends that a share of equity j is expected to deliver, PVC_{jt} is an estimate at time t of the present value of the imputation credits that a share of equity j is expected to deliver, ε_{jt} is a disturbance and α, β and γ are regression parameters. Siau, Sault and Warren use estimates of the cost of equity, inclusive of a value assigned to credits, generated by Officer's (1994) CAPM to estimate the present values of the dividends and imputation credits that firms are expected to distribute. [108] They assume that the market risk premium, inclusive of a value assigned to imputation credits is six per cent per annum, but they also examine the sensitivity of their results to changes in this value.

If the present values of dividends and credits were estimated without error, then, in the regression (16), α would be zero, β would be one, and γ would be the value of a one-dollar credit distributed.

Just as estimates of the cost of equity for a portfolio are likely to be more precise than estimates of the cost of equity for an individual security, estimates of the present values of the dividends and imputation credits that firms are expected to distribute are also likely to be more precise for portfolios than for individual securities. So, in addition, Siau, Sault and Warren (2015) examine the ratio of price to an estimate of the present value of dividends for

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[106] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[107] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[108] Officer, Robert R., *The cost of capital of a company under an imputation tax system*, Accounting and Finance, 1994, pages 1-17.

portfolios sorted on the basis of credit yields and dividend yields. [109] If the present values of dividends and credits were estimated without error and the market were to value credits distributed, then the ratio would exceed one and would be positively related to the credits that the portfolio delivers per dollar of dividends that it distributes.

To examine the sensitivity of their results to their choice of a valuation model, Siau, Sault and Warren (2015) also regress a stock's price on its book value, trailing and forward measures of earnings per share and the stock's credit yield. [110] This regression is motivated by the residual income valuation model of Ohlson (1995). [111]

4.1.2. Earnings yields

If imputation credits are capitalised into equity prices, then, all else constant, earnings yields should be negatively related to credit yields. Siau, Sault and Warren (2015) test this hypothesis by regressing a firm's one-year forward earnings yield on its imputation credit yield and a range of control variables that include an estimate of the firm's equity beta, the logarithm of the market capitalisation of its equity, the book-to-market ratio of its equity, forecasts of the growth in earnings per share for the firm, the firm's dividend yield and its leverage. [112]

4.2. Evidence

4.2.1. Valuation models

Siau, Sault and Warren (2015) use a sample of 468 publicly listed equities and data from 1996 to 2011. [113] In regressions of price on estimates of the present value of the dividends and imputation credits that firms are expected to distribute that use individual equities, they estimate the value of a one-dollar credit distributed to be around 30 cents. This result, however, can be treated with some caution as estimates of the present values of the dividends and imputation credits that firms are expected to distribute are likely to be imprecise for individual securities.

In contrast, Siau, Sault and Warren (2015) find little evidence from the behaviour of the ratio of price to the present value of dividends, for portfolios formed on the basis of credit yields, to support the proposition that the market places a positive value on credits distributed. [114]

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[109] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[110] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[111] Ohlson, J. A., *Earnings, Book values and dividends in equity valuation*, Contemporary Accounting Research, 1995, pages 661-687.

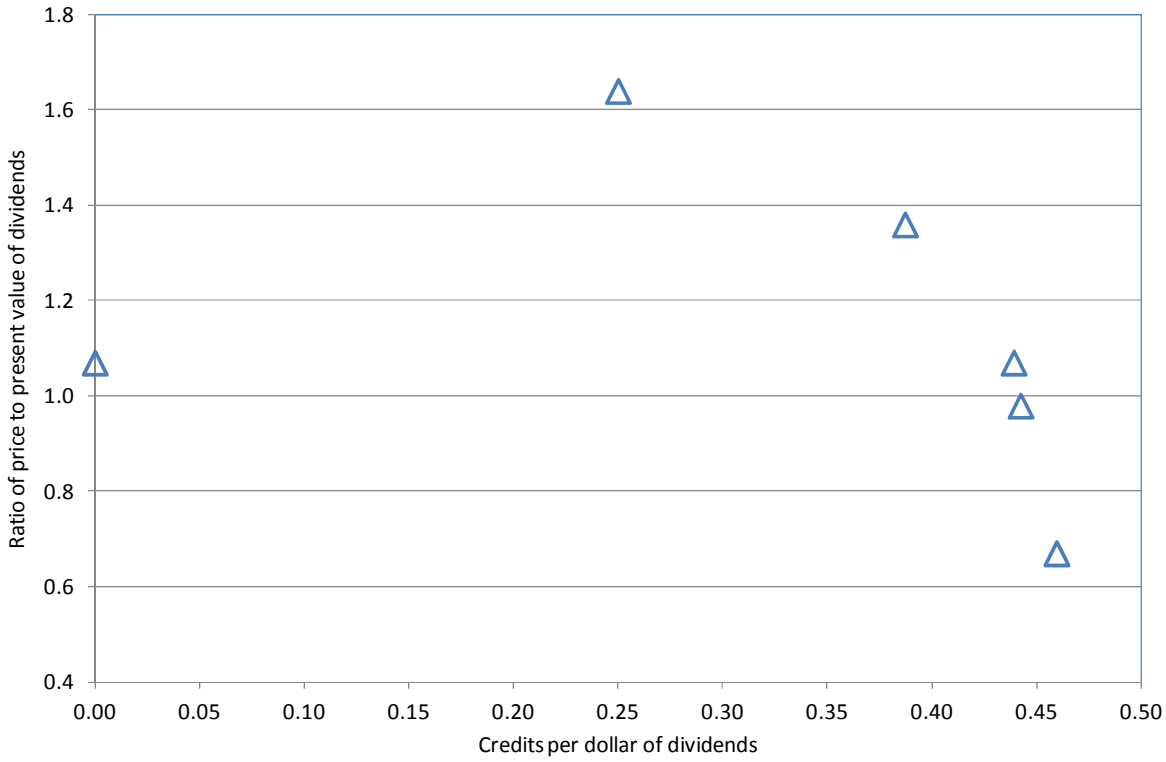
[112] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[113] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[114] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

Figure 4.1 below plots the ratio of price to the present value of dividends against credits delivered per dollar of dividends distributed for six portfolios formed on the basis of credit yields from Panel A of Table 5 of their paper. If the present values of dividends and credits were estimated without error and the market were to value credits distributed, then this ratio would on average exceed one. Testing this proposition is problematic because the result will hinge on the assumption one makes about the market risk premium, inclusive of a value assigned to credits. If the market were to place a value on credits distributed, however, the ratio would also be positively related to credits delivered per dollar of dividends distributed. The results of a test of this proposition do not hinge on the assumption one makes about the market risk premium.

Figure 4.1
Relation between ratio of price to present value of dividends and credits per dollar of dividends for portfolios formed on the basis of credit yields



Note: The market risk premium, inclusive of a value assigned to imputation credits, is assumed to be six per cent per annum. The graph uses results drawn from Panel A of Table 5 of Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

Figure 4.1 is based on an assumption that the market risk premium is six per cent per annum and provides little evidence of a positive relation between the ratio of price to the present value of dividends and credits delivered per dollar of dividends distributed. An estimate of the correlation between the two quantities for the six portfolios is -0.31.

Using a regression of stock price on book value, trailing and forward earnings per share and credit yield inspired by the residual income valuation model of Ohlson (1995), Siau, Sault and Warren (2015) do find some evidence that the market values credits distributed. [115] Unfortunately, however, because of the way in which the regression is set up it is not possible to extract an estimate from the results of the value that the market places on credits distributed. One can only conclude that the results of the regression provide evidence that the market values credits distributed.

4.2.2. Earnings yields

If imputation credits are capitalised into equity prices, then, all else constant, earnings yields should be negatively related to credit yields. Siau, Sault and Warren (2015) test this hypothesis by regressing a firm's one-year forward earnings yield on its credit yield and a range of control variables. [116] They find instead of a negative relation between earnings yields and credit yields, conditional on the control variables, a statistically significant positive relation. This evidence is not consistent with the proposition that imputation credits are capitalised into equity prices.

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[115] Ohlson, J. A., *Earnings, Book values and dividends in equity valuation*, Contemporary Accounting Research, 1995, pages 661-687.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

[116] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

5. Issues Raised by the AER and its Advisors

5.1. Background

Allen and Michaely (2003) in a review of payout policy make the following observations: [117]

> 'Researchers have almost always found that the average price drop between the cum- and the ex-day is lower than the dividend amount [see Elton and Gruber (1970), Kalay (1982), Eades, Hess, and Kim (1984), and Poterba and Summers (1984), among others].'
>
> 'Summing up, a growing body of evidence shows that within static, single-period equilibrium models, there is no convincing evidence of a significant cross-sectional relation between stocks' returns and their dividend yields.'

Handley (2010) cites this work as supporting the view of the AER that in estimating theta from drop-off studies the impact of taxes on the value of dividends should be recognised but in using the CAPM to set the cost of equity for a regulated energy utility the impact of taxes on the value of dividends should be ignored. [118] Handley states that:

> 'This approach leads to what may at first appear to be an inconsistency regarding the AER's treatment of differential taxes – in using the standard CAPM to estimate the cost of equity, the AER assumes no differential taxes but in interpreting the results of dividend drop-off studies (for the purposes of estimating gamma), the AER allows for the impact of differential taxes – however, the apparent inconsistency is of no consequence.
>
> In reaching this position, the AER has relied on two classes of empirical evidence. First, the results of U.S. dividend yield studies provide evidence that dividends are "fully valued" – equivalently, that cash dividends are valued at 100 cents in the dollar – meaning that differential taxes have no effect on prices, and so differential taxes do not need to be taken into account in estimating equity returns. Second, the results of U.S. drop-off studies provide evidence that dividends are "less than fully valued" – equivalently, that cash dividend are valued at less than 100 cents in the dollar – (due to the impact of differential taxes), and so differential taxes do need to be taken into account in estimating gamma. In other words, the AER is relying on the appropriate evidence in the appropriate context i.e. U.S. dividend yield studies in relation to the CAPM and U.S. drop-off studies in relation to gamma. Further support for this position comes from Allen and Michaely (2003) who also are neither oblivious nor overly concerned about the apparent inconsistency between the results from U.S. dividend yield and U.S. drop-off studies which they effectively attribute to methodological issues associated with the former.'

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[117] Franklin Allen is a professor at the Wharton School, University of Pennsylvania and was President of the American Finance Association in 2000 while Roni Michaely is a Professor at Cornell University.

Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

[118] Handley, J., *On the estimation of gamma*, University of Melbourne, 19 March 2010, pages 24-25.

The AER in its 2009 WACC Review states that: [119]

> 'The AER has considered all of the available evidence concerning the value of cash dividends, and concludes as follows:
>
> - The evidence from US dividend yield studies indicates that cash dividends are fully valued in total equity returns. In turn, this implies that there is no clear evidence to replace the Sharpe CAPM with an alternative tax-adjusted CAPM (e.g. Brennan CAPM), even if this option were available to AER under the NER.
>
> - The weight of evidence from US dividend drop-off studies, however, suggests that cash dividends are less than fully valued – that differential taxation (and risk) affects ex-dividend day pricing. In turn, this implies that Australian dividend drop off studies – which indicate that a $1.00 *fully franked* dividend is valued at $1.00 – support a positive value for imputation credits.'

Thus the view of the AER and its advisor Handley is that they endorse the use of yield studies like those that Allen and Michaely (2003) cite in determining whether cash dividends should be fully valued when using the CAPM to estimate the cost of equity. [120] It would be reasonable to assume, therefore, that the AER and Handley would endorse the use of a similarly constructed study, like the current study, that examines whether imputation credits distributed should be assigned a value when using the CAPM to estimate the cost of equity.

We note that among the papers that Allen and Michaely (2003) cite prominently are papers authored by Litzenberger and Ramaswamy (1979), Miller and Scholes (1982) and Kalay and Michaely (2000) and that all these authors use the method of Fama and MacBeth (1973) – either in its original form or using the modification that Litzenberger and Ramaswamy suggest that one employ. [121] Campbell (2014) describes the method of Fama and MacBeth in the following way: [122]

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[119] AER, *Final decision: Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, May 2009, page 465.

[120] Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

[121] Fama won the Nobel Prize in 2013, Miller in 1990 and Scholes in 1997.

Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

Fama, E. F. and J. D. Macbeth, *Risk, return and equilibrium: Empirical tests*, Journal of Political Economy, 1973, pages 607-636.

Kalay, A. and R. Michaely, *Dividends and taxes: A reexamination*, Financial Management 29, 2000, pages 55-75.

Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

Miller, Merton and Myron Scholes, *Dividends and taxes: Empirical evidence*, Journal of Political Economy 90, 1982, pages 1118-1141.

[122] John Campbell is a professor at Harvard University and was President of the American Finance Association in 2005.

> 'In modern panel regression terminology, the finance panel should cluster standard errors by time while a microeconomic panel should cluster standard errors by household. Fama and MacBeth present a brilliantly simple way of doing this. They suggest estimating a sequence of cross-sectional regressions of stock returns on characteristics. In each cross-section, the coefficients can be interpreted as returns on portfolios of stocks weighted by firm characteristics (an interpretation developed in Fama 1976, Chapter 9). The returns on these portfolios are serially uncorrelated given market efficiency and the assumption that the included characteristics include all those that determine expected returns. Then the time-series average return on each portfolio estimates the average effect of the given characteristic (controlling for other included characteristics), and its standard error can be calculated from the time-series variability of the portfolio return.'

With this background, we now turn to issues raised about the work of Lajbcygier and Wheatley (2012) and NERA (2013) by the AER and its advisors. [123]

5.2. The AER and Lally

Lally (2013) states that: [124]

> 'the NERA (2013b, section 3) results are completely implausible, with an estimated utilisation rate (-2.00) that is not only negative and statistically significant but economically huge. Imputation credits might have low value but their value cannot be negative. This raises the question of whether the NERA result is an artefact of the methodology, erroneous estimates of variables such as betas, or simply data input errors. To place the issue in context, this result would be akin to conducting a dividend drop-off study and finding that the drop off ratio for unfranked dividends was -2.00, i.e., share prices on average rise on ex-day rather than fall, the average rise is twice that of the dividend, and the rise is statistically significant. Results from such a study could not be treated seriously, except to highlight the fragility in the methodology, and the same applies to the NERA results.'

The AER reports that NERA estimates theta to be between -1.57 and -1.90 and states in its 2013 guideline that: [125]

> 'We consider the large negative results from the NERA equity returns study are implausible, and indicate this study is not reliable. This accords with Lally's advice in his expert report.'

The AER and Lally raise a number of issues and we consider each in turn.

Campbell, J.Y., *Empirical asset pricing: Eugene Fama, Lars Peter Hansen, and Robert Shiller*, Scandinavian Journal of Economics, 2014, forthcoming.

123 Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

124 Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

125 AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

First, the AER (2013) and Lally (2013) charge that the results that Lajbcygier and Wheatley (2012) and NERA (2013) report are implausible. [126] There are a number of points to make about this charge.

a. The tests that Lajbcygier and Wheatley (2012) and NERA (2013) conduct are *joint* tests of a pricing model and of the proposition that theta is nonnegative. [127] Thus while theta the parameter cannot be negative, an estimate of theta produced using their tests can be negative if there is something wrong with the pricing model that is being tested.

   The statistically significant estimates of -1.57, -1.90 and -2.00 that the AER (2013) and Lally (2013) report that NERA (2013) finds are constructed using Officer's CAPM – a version of the Sharpe-Lintner CAPM that allows a representative investor to place a value on distributed credits. [128] This is the model that the AER uses in setting a cost of equity for a regulated energy utility. Again, theta the parameter cannot be negative. Thus, unless it can be shown that there is something wrong with the work of Lajbcygier and Wheatley (2012) and NERA, what is implausible is the idea that the Sharpe-Lintner CAPM works. [129] The model that the AER uses implies that there should be a negative relation between risk-adjusted excess returns and risk-adjusted credit yields, where the Sharpe-Lintner CAPM is used to make the adjustments, and the evidence simply does not support the implication.

   What the AER (2013) and Lally (2013) do not say is that estimates of theta produced by Lajbcygier and Wheatley (2012) and NERA (2013) that employ the Black CAPM – a model which we have urged the AER elsewhere to use – do not differ significantly from zero. [130] Estimates that use individual securities are the most precise – as

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[126] AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[127] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[128] AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[129] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

[130] AER, *Better Regulation, Explanatory Statement Rate of Return Guideline (Appendices)*, December 2013, pages 173-174.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

Litzenberger and Ramaswamy (1979) argue will be the case – and a 95 per cent confidence interval for theta produced from Table 3.5 of the current report that uses the Black CAPM and data from July 2000 to December 2013 is -0.94 ± 1.96× 0.59, that is, -2.10 to 0.22. [131] This confidence interval includes many values for theta the parameter that are implausible but also contains many values that are plausible. Values for theta that lie within the range of zero to 0.22, for example, are plausible. The confidence interval also, however, excludes values for theta the parameter that others have recommended one use. The confidence interval excludes the value of 0.35 that SFG (2015) recommend one use and the range of 0.40 to 0.70 that the AER (2014) constructs based on ownership rates. [132]

b. The AER (2014) states more broadly that: [133]

> 'The limitations of implied market value studies include:
>
> - These studies can produce nonsensical estimates of the utilisation rate; that is, greater than one or less than zero.'

This statement suggests that the AER has strong prior beliefs about the value of theta and is not open to the idea that theta may be approximately zero. In other words, the statement suggests that the AER is not entirely willing for the data to direct its choice of a value for theta. To see this, note that if theta the parameter is zero, then the mean of an unbiased estimator for theta will be zero. If, however, the estimator is symmetrically distributed, then on average one half of the estimates produced using the estimator will be negative and will be deemed to be 'nonsensical' by the AER. An unwillingness to consider *estimates* of theta that are negative implies that the AER is unwilling to contemplate the idea that theta the parameter may be close to zero.

c. The summary statistics that we report in Table 3.2 indicate that a zero-investment position that is long portfolio 7 and short portfolio 1 would have delivered a return, exclusive of credits, of 5.95 – (-0.57) = 6.52 per cent per annum and a credit yield of 3.30 per cent per annum and the beta of the position would have been 0.81 – 1.45 = -0.64. The position, though, while it would have been undeniably attractive for a tax exempt institution, would not have offered arbitrage opportunities because it

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NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

131 Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

132 AER, *Draft decision for Jemena Gas Networks (NSW) Ltd Access Arrangements 2015-20, Attachment 4 – Value of imputation credits*, November 2014, pages 14-15.

SFG, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy;* February 2015, page 4.

133 AER; *Draft decision for Jemena Gas Networks (NSW) Ltd Access Arrangements 2015-20, Attachment 4 – Value of imputation credits;* November 2014 (pdf version).

would not have been risk-free. The standard deviation of the return to the position would have been 22.78 per cent per annum.

Second, Lally (2013) asserts that there may be something wrong with the methodology that NERA uses. [134] We note simply that:

a. The AER (2009) and its advisor Handley (2010) have endorsed the use of yield studies like those that Allen and Michaely (2003) cite in determining whether cash dividends should be fully valued when employing the CAPM to estimate the cost of equity and the work of Lajbcygier and Wheatley (2012) and NERA (2013) uses a methodology that almost exactly matches the methodology that these yield studies employ. [135]

b. Past President of the American Finance Association Professor John Campbell of Harvard University has described, as recently as last year, the Fama-MacBeth method that we use as: [136]

> 'brilliantly simple'

Third, Lally (2013) asserts that the estimates of beta that NERA computes may be erroneous. [137] We note that:

a. NERA computes estimates of beta using ordinary least squares in exactly the same way as the yield studies that Allen and Michaely (2003) review and whose results the AER (2009) uses in choosing a model with which to estimate the cost of equity. [138]

b. The AER (2014) relies in large part on estimates of beta computed by Henry (2014) using ordinary least squares. [139]

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134 Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

135 AER, *Final decision: Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, May 2009, page 465.

Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

Handley, J., *On the estimation of gamma*, University of Melbourne, 19 March 2010, pages 24-25.

Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

136 John Campbell is a professor at Harvard University and was President of the American Finance Association in 2005.

Campbell, J.Y., *Empirical asset pricing: Eugene Fama, Lars Peter Hansen, and Robert Shiller*, Scandinavian Journal of Economics, 2014, forthcoming.

137 Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

138 AER, *Final decision: Electricity transmission and distribution network service providers, Review of the weighted average cost of capital (WACC) parameters*, May 2009, page 465.

Allen, F. and R. Michaely, *Payout policy*, In the Handbook of Economics and Finance, Volume 1A, Corporate Finance, edited by George Constantinides, Milton Harris, and Rene Stulz, 2003, Chapter 7.

Finally, Lally (2013) asserts that NERA may have made data entry errors. [140] We note that:

a. What Lally (2013) does not say is that Siau, Sault and Warren (2013) have independently verified the results of Lajbcygier and Wheatley (2012) – which are themselves very similar to the results of NERA (2013). [141] Siau, Sault and Warren state that: [142]

> 'We took the opportunity to re-investigate the relation between returns and imputation credits under both the CAPM and 3-factor model of Fama and French (1993), including using 6-monthly returns to span dividend events. The results were similar to Lajbcygier and Wheatley (2012), thus confirming their findings.'

b. NERA (2013) does not enter any data but instead relies on data provided by SIRCA, Ken French and the Reserve Bank of Australia. [143]

We conclude that Lally's (2013) comments amount to nothing more than speculation. [144] We note that:

a. Siau, Sault and Warren (2013) have independently verified the results of Lajbcygier and Wheatley (2012) – which are themselves very similar to the results of NERA (2013). [145]

b. No request has been made by Lally to NERA for the programs that it uses.

c. The SIRCA data that we use is, for a fee, publicly available and so Lally should have been able to ascertain by now whether there were *genuinely* any problems with the work of NERA. [146]

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[139] AER, *Draft decision for Jemena Gas Networks (NSW) Ltd Access Arrangements 2015-20, Attachment 3 – Rate of return*, November 2014, page 267.

Henry, O., *Estimating β: An update*, April 2014.

[140] Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

[141] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Australian National University, 18 June 2013, page 10.

[142] Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Australian National University, 18 June 2013, page 10.

[143] NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[144] Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, page 22.

[145] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Australian National University, 18 June 2013, page 10.

5.3. Handley and Lally

Handley (2014) and Lally (2013) suggest that setting theta to be zero will require that an international pricing model be used. [147] For example, Handley states that: [148]

> 'If one disagrees with this notion of segmentation, then the solution is to bring other assets and investors into the model – for example, use an international CAPM which prices domestic assets relative to an international benchmark rather than relative to a domestic benchmark.'

Similarly, Lally states that: [149]

> 'the use of the Officer model is inconsistent with an estimate of the utilisation rate on imputation credits that is less than 1 because the Officer model assumes that national equity markets are segmented whilst an estimate of the utilisation rate on imputation credits of less than 1 reflects the presence of foreign investors.'
>
> 'Turning now to complete integration of national markets for risky assets, versions of the CAPM have been developed that recognize that international investment opportunities are open to investors, starting with Solnik (1974). We will invoke this model because, dividend imputation aside, it closely parallels the Officer model.'

We have shown elsewhere in a February 2015 report that a domestic version of the Sharpe-Lintner CAPM tends to underestimate the returns to low-beta stocks. [150] We show here that the same is true for an international version of the Sharpe-Lintner CAPM. The out-of-sample tests that we conduct use 10 portfolios formed on the basis of past domestic estimates of beta and we describe the formation of these portfolios in our February 2015 report. We use as a measure of the return to the world market portfolio the return to the MSCI world index and we measure all returns in Australian dollars.

If $\hat{z}_{mt}$, the regulator's assessment of the market risk premium, is rational, that is, unbiased, then:

$$\mathrm{E}(\hat{z}_{mt}) = \mathrm{E}(z_{mt}) \tag{17}$$

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146 We note that the Victoria University of Wellington, the institution at which Lally is an Associate Professor is a member of SIRCA.

http://www.sirca.org.au/about-sirca/members/

147 Handley, J.C., *Report prepared for the Australian Energy Regulator: Advice on the value of imputation credits*, University of Melbourne, September 2014.

Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013.

148 Handley, J.C., *Report prepared for the Australian Energy Regulator: Advice on the value of imputation credits*, University of Melbourne, September 2014, page 23.

149 Lally, *Estimating gamma*, Victoria University, Wellington, 25 November 2013, pages 31 and 38.

150 NERA, *Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy*, February 2015.

It follows that if forecasts generated by the Sharpe-Lintner CAPM are unbiased and the regulator's assessment of the market risk premium is rational, then:

$$\mathrm{E}(z_{jt} - \hat{\beta}_{jt} z_{mt}) = 0, \tag{18}$$

where $\hat{\beta}_{jt}$ is an unbiased estimate of the beta of portfolio j at time t.[151]

We test whether the restriction (18) holds true by examining whether its sample counterpart:

$$\frac{1}{T}\sum_{t=1}^{T}(z_{jt} - \hat{\beta}_{jt} z_{mt}) \tag{19}$$

differs significantly from zero.

The quantity (19) is the mean difference between two zero-investment strategies:

- the quantity z_{jt} is the return to a zero-investment strategy that is long portfolio j and short the risk-free asset.
- the quantity $\hat{\beta}_{jt} z_{mt}$ is the return to a zero-investment strategy that is long the market portfolio and short the risk-free asset.

If the Sharpe-Lintner CAPM generates forecasts that are unbiased and the regulator's assessment of the market risk premium is rational, then the mean difference between the returns to the two zero-investment strategies should be zero.

Table 5.1 below provides the results of tests of a domestic version of the Sharpe-Lintner CAPM that use a value for theta of one and an international version of the Sharpe-Lintner CAPM that use a value for theta of zero. These tests use rolling estimates of beta that employ the previous five years of data. The table shows that assets that have low domestic betas also tend to have low betas relative to the world market portfolio and that both versions of the model badly underestimate the returns required on low-beta assets. Wald statistics easily reject both models.

Thus while the Australian economy is relatively small and open, the evidence that we provide indicates that an international version of the Sharpe-Lintner CAPM performs no better than a domestic version of the Sharpe-Lintner CAPM. This does not imply that the Australian economy should not be viewed as small and open or that theta should be set to one. The evidence merely indicates that an international version of the Sharpe-Lintner CAPM does not work well. Thus we do not advise that the model be used to determine the cost of equity for an Australian regulated energy utility.

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[151] Note that $\hat{\beta}_{jt}$ will be computed using data from before period t and so will typically be distributed independently of z_{mt}. It will also typically be distributed independently of $\hat{z}_{mt}$. See, for example:

Shanken, J., *On the estimation of beta pricing models*, Review of Financial Studies 5, 1992, pages 1-33.

Table 5.1
Out-of-sample tests of domestic and international versions of the Sharpe-Lintner CAPM that use portfolios formed on the basis of past domestic estimates of beta

	Domestic model		International model	
Portfolio	β	Mean forecast error	β	Mean forecast error
1	0.55	**6.18**	0.27	**6.94**
		(1.91)		(2.38)
2	0.58	**6.12**	0.26	**6.43**
		(1.85)		(2.48)
3	0.67	**4.69**	0.40	**6.36**
		(1.78)		(2.42)
4	0.78	**6.05**	0.37	**7.67**
		(1.70)		(2.64)
5	0.95	2.82	0.40	**5.72**
		(1.73)		(2.99)
6	0.99	1.42	0.47	4.16
		(1.49)		(2.88)
7	1.10	-1.78	0.49	1.75
		(1.68)		(3.20)
8	1.23	-1.69	0.51	1.00
		(1.90)		(3.74)
9	1.33	**-5.99**	0.55	-3.00
		(2.29)		(4.24)
10	1.37	-5.17	0.51	-1.72
		(3.77)		(5.36)
Wald		**35.02**		**29.80**
		[0.00]		[0.00]

Notes: The domestic model uses an assumption that theta is one while the international model uses an assumption that theta is zero. The results are for the period January 1979 to December 2013 and use rolling estimates of beta computed using five years of data. Sample mean forecast errors in per cent per annum are outside of parentheses while the standard errors of the means are in parentheses. Estimates of β are the averages of the rolling estimates. Wald statistics for tests of each model are outside of brackets while the p-values associated with the statistics are in brackets. Mean forecast errors that differ significantly from zero at the five per cent level are in bold. Wald statistics that lead to a rejection of a model at the five per cent level are also in bold.

5.4. Drop-Off Studies

Drop-off studies typically provide estimates of theta that are positive and significant. For example, SFG (2015) provide an estimate of theta computed from a drop-off study of 0.35. [152] As Lajbcygier and Wheatley (2012), however, point out: [153]

> 'If, for example, transaction costs discourage foreign investors from engaging in ex-day strategies more than they discourage domestic investors, but transaction costs have little impact on the long-term investment plans of foreign investors, then estimates of the value that investors place on imputation credits, derived from ex-day studies, can overestimate the value that a long-term investor places on the credits.'

Similarly, SFG (2014) states about the impact of short-term traders on estimates of theta drawn from drop-off studies that: [154]

> 'To the extent that this effect is material, it results in the dividend drop-off being higher than it would otherwise be, which in turn results in the estimate of theta being higher than it would otherwise be.
>
> That is, to the extent that the increase in trading volume around the ex-dividend date has an effect, it is likely to result in an over-estimate of theta.'

The evidence that we provide and that Siau, Sault and Warren (2015) provide is consistent with this idea. Many of the estimates of theta that we produce sit significantly below 0.35. Thus our evidence supports the conclusion of SFG (2015) that: [155]

> 'I remain of the view that 0.35 is a conservative estimate of the market value of distributed imputation credits.'

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[152] SFG, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy;* February 2015, page 4.

[153] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 478.

[154] SFG, *An appropriate regulatory estimate of gamma: Report for Jemena Gas Networks, ActewAGL, APA, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), ENERGEX, Ergon, Transend, TransGrid and SA Power Networks*, 21 May 2014, pages 31-32.

[155] SFG, *Estimating gamma for regulatory purposes, Report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausnet Services Directlink, Networks NSW (Ausgrid, Endeavour Energy and Essential Energy), Citipower, Powercor, ENERGEX, Ergon, SA Power Networks, Australian Gas Networks and United Energy;* February 2015, page 4.

Appendix A. The Redemption Rate and Theta

This appendix provides a derivation of a simple version of the model that Officer suggests that one can use to compute the return required on equity.

We assume that there are two risky asset – one domestic and one foreign – and that each investor seeks to minimise: [156]

$$\frac{\varphi}{2}\sigma^2(W_{1j}) - \mathrm{E}(W_{1j}) \tag{A.1}$$

where φ is a measure of the risk aversion of each investor and the end-of-period wealth of investor j is given by:

$$W_{1j} = 1 + x_{1j}(r_1 + \theta_j c_1) + x_{2j} r_2 + (1 - x_{1j} - x_{2j}) r_f \tag{A.2}$$

where

x_{ij} = the weight placed by investor j in the risky asset i;

r_i = the return to risky asset i;

θ_j = the value placed by investor j on a one dollar tax credit;

c_1 = the credit yield attached to asset 1 – assumed to be known at the start of the period; and

r_f = the risk-free rate.

Asset 1 is the domestic risky asset, which we assume delivers imputation credits, while asset 2 is the foreign risky asset which delivers no credits.

We assume that imputation credits can be redeemed immediately and so for domestic investors $\theta_j = 1$ while for foreign investors $\theta_j = 0$.

There are *D* domestic investors and *F* foreign investors and start-of-period wealth for each investor is one dollar.

A.1. Interpretation of Theta

The first-order conditions for each domestic investor are:

$$\mathrm{E}(r_i) + c_i - r_f = \varphi \mathrm{Cov}(r_i, W_{1j}), \quad i = 1, 2 \tag{A.3}$$

while the first-order conditions for each foreign investor are:

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[156] Ingersoll (1987) shows that if the returns to the two risky assets are bivariate normal, then an investor who displays constant absolute risk aversion of φ will seek to minimise the quantity (A.1).

Ingersoll, J., 1987, *Theory of financial decision making*, Rowman and Littlefield, page 98.

$$\mathrm{E}(r_i) - r_f = \varphi \mathrm{Cov}(r_i, W_{1j}), \quad i = 1,2 \tag{A.4}$$

Using (A.3) and (A.4) and aggregating over all investors yields:

$$(D+F)\left(\mathrm{E}(r_1) - r_f\right) + Dc_1 = \varphi \mathrm{Cov}(r_1, W_{1m}) \tag{A.5}$$

and

$$(D+F)\left(\mathrm{E}(r_2) - r_f\right) = \varphi \mathrm{Cov}(r_2, W_{1m}) \tag{A.6}$$

where end-of-period world wealth is given by:

$$W_{1m} = \sum_j W_{1j} = (D+F) + \sum_j x_{1j}(r_1 + \theta_j c_1) + \sum_j x_{2j} r_2 + \sum_j (1 - x_{1j} - x_{2j}) r_f \tag{A.7}$$

Define the credit yield of the world market portfolio of risky assets to be:

$$c_m = \left(\sum_j (x_{1j} + x_{2j}) \right)^{-1} \sum_j x_{1j} c_1 \tag{A.8}$$

and the return on the world market portfolio of risky assets to be:

$$r_m = \left(\sum_j (x_{1j} + x_{2j}) \right)^{-1} \sum_j (x_{1j} r_1 + x_{2j} r_2) \tag{A.9}$$

Then from (A.5), (A.6), (A.7) and (A.9):

$$\mathrm{E}(r_i) + \theta c_i - r_f = \beta_i \left(\mathrm{E}(r_m) + \theta c_m - r_f \right), \qquad i = 1,2, \tag{A.10}$$

where c_i is the credit yield of risky asset i and:

$$\theta = \frac{D}{D+F} \tag{A.11}$$

measures the impact of imputation credits distributed on the return required on domestic equity. θ is the value placed on a dollar of tax credits by a representative investor. If there are few domestic investors relative to foreign investors, the representative investor will most closely resemble a foreign investor and the impact of imputation credits distributed on the return required on domestic equity will be negligible as, in the model, a foreign investor places no value on credits received.

A.2. Relation between Redemption Rate and Theta

Solving the first-order conditions (A.3) for the weights placed by each domestic investor in each risky asset yields:

$$\begin{pmatrix} x_{1j} \\ x_{2j} \end{pmatrix} = \varphi^{-1} \begin{pmatrix} \sigma^2(r_1) & \mathrm{Cov}(r_1, r_2) \\ \mathrm{Cov}(r_1, r_2) & \sigma^2(r_2) \end{pmatrix}^{-1} \begin{pmatrix} \mathrm{E}(r_1) + c_1 - r_f \\ \mathrm{E}(r_2) - r_f \end{pmatrix}$$

$$= \varphi^{-1} \left(\sigma^2(r_1)\sigma^2(r_2) - \left(\mathrm{Cov}(r_1, r_2)\right)^2 \right) \begin{pmatrix} \sigma^2(r_2)\left(\alpha_{12} + c_1\right) \\ \sigma^2(r_1)\alpha_{21} - \sigma^2(r_1)\beta_{21}c_1 \end{pmatrix} \qquad \text{(A.12)}$$

while solving the first-order conditions (A.4) for the weights placed by each foreign investor in each risky asset yields:

$$\begin{pmatrix} x_{1j} \\ x_{2j} \end{pmatrix} = \varphi^{-1} \begin{pmatrix} \sigma^2(r_1) & \mathrm{Cov}(r_1, r_2) \\ \mathrm{Cov}(r_1, r_2) & \sigma^2(r_2) \end{pmatrix}^{-1} \begin{pmatrix} \mathrm{E}(r_1) - r_f \\ \mathrm{E}(r_2) - r_f \end{pmatrix}$$

$$= \varphi^{-1} \left(\sigma^2(r_1)\sigma^2(r_2) - \left(\mathrm{Cov}(r_1, r_2)\right)^2 \right) \begin{pmatrix} \sigma^2(r_2)\alpha_{12} \\ \sigma^2(r_1)\alpha_{21} \end{pmatrix}, \qquad \text{(A.13)}$$

where:

$$\alpha_{12} = \mathrm{E}(r_1) - r_f - \beta_{12}\left(\mathrm{E}(r_2) - r_f\right), \qquad \beta_{12} = \frac{\mathrm{Cov}(r_1, r_2)}{\sigma^2(r_2)},$$

$$\alpha_{21} = \mathrm{E}(r_2) - r_f - \beta_{21}\left(\mathrm{E}(r_1) - r_f\right), \qquad \beta_{21} = \frac{\mathrm{Cov}(r_1, r_2)}{\sigma^2(r_1)} \qquad \text{(A.14)}$$

α_{12} is the alpha (exclusive of credits) of the domestic risky asset (risky asset 1) relative to the foreign risky asset (risky asset 2). This alpha measures the benefit to a foreign investor of holding the domestic risky asset.

α_{21} is the alpha (exclusive of credits) of the foreign risky asset (risky asset 2) relative to the domestic risky asset (risky asset 1). This alpha measures the benefit to a foreign investor of holding the foreign risky asset.

The rate at which credits distributed are redeemed will be given by the ratio of domestic holdings of the domestic risky asset (risky asset 1) to the sum of domestic and foreign holdings of the asset. From (A.12) and (A.13) this ratio will be given by:

$$\frac{\alpha_{12}D + Dc_1}{\alpha_{12}(D + F) + Dc_1}, \qquad \text{(A.15)}$$

From (A.13), if $\alpha_{12} > 0,$ then the foreign investor will hold a long position in the domestic risky asset. Under these circumstances, the redemption rate given by (A.15) will lie between θ and one and so the redemption rate will provide an upper bound for the parameter θ. The gap between the redemption rate and θ will be large, however, if the benefit to a foreign

investor of holding the domestic risky asset is small relative to the credit yield of the domestic risky asset. Suppose, for example that $D = 2, F = 98, \alpha_{12} = 0.0002$ and $c_1 = 0.02$. That is, suppose that the domestic population makes up 2 per cent of the world's population, there is little benefit to a foreign investor to investing in the domestic risky asset relative to investing in the foreign risky asset and the credit yield attached to the domestic risky asset is 2 per cent. Then $\theta = 2 \div (2 + 98) = 0.02$ and the redemption rate will be $(2 \times 0.0002 + 2 \times 0.02) \div ((2 + 98) \times 0.0002 + 2 \times 0.02) = 0.67$, that is, substantially larger.

If $\alpha_{12} = 0,$ then the foreign investor will not hold a position in the domestic risky asset. Under these circumstances, the redemption rate given by (A.15) will equal one and so the redemption rate will again provide an upper bound for the parameter θ.[157]

If $\alpha_{12} < 0,$ then the foreign investor will hold a short position in the domestic risky asset. Under these circumstances, the redemption rate given by (A.15) will lie above one. The model is not well equipped to analyse a situation of this kind, however, because the model presumes that a foreign investor who shorts the domestic risky asset does not have to supply credits to the domestic investor who holds the asset long.

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[157] Our March 2015 report mistakenly stated that if $\alpha_{12} = 0,$ the redemption rate would match θ. This will happen when $\alpha_{12}^{-1} = 0,$ that is, as $\alpha_{12} \to \infty$ and not when $\alpha_{12} = 0$. Even as $\alpha_{12} \to \infty,$ however, the redemption rate will still provide an upper bound for θ.

NERA, *Estimating Distribution and Redemption Rates from Taxation Statistics, A report for Jemena Gas Networks, Jemena Electricity Networks, AusNet Services, Australian Gas Networks, CitiPower, Powercor, SA PowerNetworks and United Energy*, March 2015., page 32.

Appendix B. Two-Pass Methodology

Each model that we use imposes a restriction of the form:

$$\mathrm{E}\left(z_{jt} - \gamma_{0t} + \gamma_{1t} c_{jt} - \gamma_{2t} d_{jt}\right) = \beta_{jt} \mathrm{E}\left(z_{pt} - \gamma_{0t} \iota_k + \gamma_{1t} c_{pt} - \gamma_{2t} d_{pt}\right), \qquad \text{(B.1)}$$

where z_{jt} is the return on stock j in excess of the risk-free rate from month $t-1$ to month t, c_{jt} is the stock's credit yield, d_{jt} is the stock's dividend yield in excess of the risk-free rate, z_{pt} is a $k \times 1$ vector of factors whose first element is the return to a zero-investment strategy that is long the market portfolio and short the risk-free asset and whose other elements, if any, are the returns to other zero-investment strategies, c_{pt} is a $k \times 1$ vector of factor credit yields, d_{pt} is a $k \times 1$ vector whose first element is the market portfolio's dividend yield in excess of the risk-free rate and whose other elements, if any, are factor dividend yields, β_{jt} is a $1 \times k$ vector of betas, ι_k is a $k \times 1$ vector whose first element is one and whose remaining elements, if any, are zeroes, γ_{0t} is the mean return on a zero-beta portfolio in excess of the risk-free rate, γ_{1t} is the dollar value that the market places on a one-dollar credit distributed and γ_{2t} is the additional dollar with-dividend return that the market requires on a stock for each additional dollar of dividends paid.[158] If $k = 1$ and $\gamma_{0t} = \gamma_{1t} = 0,$ then (B.1) collapses to Officer's CAPM in which credits distributed can lower the without-credit cost of equity. If, on the other hand, $k = 1$ and $\gamma_{1t} = 0,$ then (B.1) collapses to the version of the CAPM that Litzenberger and Ramaswamy (1979) test in which dividends distributed can raise required returns.[159]

To estimate the parameters of each model, we use the two-pass methodology of Fama and MacBeth (1973) and Litzenberger and Ramaswamy (1979).[160]

In the first pass, for each stock j and month t least squares estimates are computed of the parameters of the time-series regression:

$$z_{jt-s} = \alpha_{jt} + \beta_{jt} z_{pt-s} + \varepsilon_{jt-s}, \qquad s = 1,2,...,S, \qquad \text{(B.2)}$$

where α_{jt} and ε_{jt-s} are the regression intercept and disturbance. Like Litzenberger and Ramaswamy and Kalay and Michaely (2000), we choose the number of months S used to compute the estimates to be 60.[161]

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158 The factors that we use are the returns to zero-investment strategies and so their credit yields and dividend yields are the differences between the credit yields and dividend yields of two sets of portfolios.

159 Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

160 Fama, E. F. and J. D. Macbeth, *Risk, return and equilibrium: Empirical tests*, Journal of Political Economy, 1973, pages 607-636.

Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

In the second pass, for each month t weighted least squares estimates are computed of the parameters of the cross-sectional regression:

$$\hat{y}_{jt} = \hat{x}_{jt}\Gamma_t + \eta_{jt}, \qquad j = 1,2,...,N_t, \quad t = 1,2,...,T, \tag{B.3}$$

where $\hat{y}_{jt} = z_{jt} - \hat{\beta}_{jt} z_{pt}$, $\hat{\beta}_{jt}$ is the least squares estimate of β_{jt} computed using data from $t-S$ to $t-1$, $\hat{x}_{jt}$ is the 1×3 vector:

$$\left[\; (1 - \hat{\beta}_{jt} \iota_k) \qquad (\hat{\beta}_{jt} c_{pt} - c_{jt}) \qquad (d_{jt} - \hat{\beta}_{jt} d_{pt}) \; \right] \tag{B.4}$$

or, depending on the model, a row vector containing a subset of the elements of (B.4) and Γ_t is the 3×1 vector

$$\left[\gamma_{0t} \qquad \gamma_{1t} \qquad \gamma_{2t} \right]' \tag{B.5}$$

or, again depending on the model, a column vector containing a subset of the elements of (B.5).

The weighted least squares estimator for Γ_t is given by

$$\hat{\Gamma}_t = \left(\sum_{j=1}^{N_t} \hat{x}_{jt}' \hat{\sigma}_{jt}^{-2} \hat{x}_{jt} \right)^{-1} \sum_{j=1}^{N_t} \hat{x}_{jt}' \hat{\sigma}_{jt}^{-2} \hat{y}_{jt}, \tag{B.6}$$

where $\hat{\sigma}_{jt}^2$ is an unbiased estimate of the variance of the regression disturbance ε_{jt-s} computed using data from months *t*-*S* through *t*-1.

Since the least squares estimate of the vector of betas measures the vector with error, the second-pass estimator of Γ_t will be biased. Litzenberger and Ramaswamy (1979) suggest that to address this issue, one use a modified estimator to take into account the errors-in-variables problem. [162] The modified estimator that we use is:

$$\hat{\Gamma}_t = \left(\sum_{j=1}^{N_t} \left(\hat{x}_{jt}' \hat{\sigma}_{jt}^{-2} \hat{x}_{jt} - \lambda w_{jt}' \hat{\Omega}_{jt}^{-1} w_{jt} \right) \right)^{-1} \sum_{j=1}^{N_t} \left(\hat{x}_{jt}' \hat{\sigma}_{jt}^{-2} \hat{y}_{jt} - \lambda \, w_{jt}' \hat{\Omega}_{jt}^{-1} v_{jt} \right), \tag{B.7}$$

where $\hat{\Omega}_{jt}$ is an unbiased estimate of the covariance matrix of the vector of factors z_{pt-s} computed using data from months $t-S$ through $t-1$, $\lambda = (S-k-1)/((S-1)(S-k-3))$, $v_{jt} = -z_{pt}$, and

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[161] Kalay, A. and R. Michaely, *Dividends and taxes: A reexamination*, Financial Management 29, 2000, pages 55-75.

[162] Litzenberger, R. and K. Ramaswamy, *The effects of personal taxes and dividends on capital asset prices: Theory and empirical evidence*, Journal of Financial Economics, 1979, pages 163-195.

$$w_{jt} = [\ -\iota_k \quad c_{pt} \quad -d_{pt}\ ] \tag{B.8}$$

or, depending on the model, a matrix containing a subset of the columns of (B.8). [163]

[163] To see how the modification arises, note that if $\varepsilon_{jt-s} \sim \text{NID}(0, \sigma^2_{jt})$, then, conditional on the factors, $(S-k-1)\hat{\sigma}^2_{jt} / \sigma^2_{jt} \sim \chi^2_{S-k-1}$, $\text{E}(\hat{\sigma}^{-2}_{jt}\ \sigma^2_{jt} / (S-k-1)) = 1/(S-k-3)$ and

$$\text{E}(\hat{x}_{jt}'\ \hat{\sigma}^{-2}_{jt}\ \hat{x}_{jt}) = (S-1)\,\lambda\, x_{jt}'\ \sigma^{-2}_{jt}\ x_{jt} + \lambda\, w_{jt}'\ \hat{\Omega}^{-1}_{jt}\ w_{jt},$$

$$\text{E}(\hat{x}_{jt}'\ \hat{\sigma}^{-2}_{jt}\ \hat{y}_{jt}) = (S-1)\,\lambda\, x_{jt}'\ \sigma^{-2}_{jt}\ y_{jt} + \lambda\, w_{jt}'\ \hat{\Omega}^{-1}_{jt}\ v_{jt}$$

For further details, see Shanken (1992).

Shanken, J., *On the estimation of beta pricing models*, Review of Financial Studies 5, 1992, pages 1-33.

Appendix C. Terms of Reference

Expert Terms of Reference

Do Imputation Credits Lower the Cost of Equity? Cross-Sectional Tests

United Energy **28 April 2015**

Background

The Australian Energy Regulator (AER) is empowered to make five yearly regulatory determinations that control the aggregate average prices charged by regulated energy network businesses. The rules provide for a Regulated Asset Base (RAB) to be established and updated annually and for an operational expenditure allowance. A further key component of the regulatory determination is the allowed rate of return for debt and equity (or weighted average cost of capital) for funding the business. The principal rules governing how the AER sets the allowed rate of return on debt for electricity distribution businesses are contained in rule 6.5.2 of the National Electricity Rules (see attached). The same rules in essentially the same terms apply to gas distribution businesses.

When the AER exercises the relevant regulatory powers under the National Electricity Rules, it is also required to apply section 16 of the National Electricity Law (see attached). Specifically, section 16 provides that *the AER must, in performing or exercising an AER economic regulatory function or power – (a) perform or exercise that function or power in a manner that will or is likely to contribute to the achievement of the national electricity objective*.…That national electricity objective is set out in section 7 of the National Electricity Law as: '*The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to- (a) price, quality, safety, reliability and security of supply of electricity; and (b) the reliability, safety and security of the national electricity system.*'

Additionally the Rules require the AER to publish a Rate of Return Guideline which explains how the regulator intends to apply the Rules (attached). The AER has recently made a preliminary determination for Jemena Gas Networks applying the Rules (attached).

The National Electricity Rules require that the estimated cost of corporate income tax for a network service provider include a value for imputation credits, gamma. [164] Gamma represents the value that equity investors place on imputation credits created through the payment of company income tax and is generally estimated as the product of two elements:

- the *payout* ratio, being the proportion of created credits distributed by companies to their shareholders; and

[164] Australian Energy Market Commission, *National Electricity Rules Version 69*, page 661.

- *theta*, the market value of distributed imputation credits as a proportion of their face value.

In the AER's post tax revenue model the value of gamma is used to determine the proportion of the assumed company income tax that does not need to be included in a regulated firm's annual revenue requirement. The AER's framework presumes that imputation credits distributed lower the without-credit cost of equity. Put another way, the AER uses a framework that presumes that the market places a higher value on a firm that distributes imputation credits than on an otherwise identical firm that distributes no credits. Lajbcygier and Wheatley (2012) test the proposition that imputation credits distributed lower the without-credit cost of equity while Siau, Sault and Warren (2015) test the proposition that the market places a higher value on a firm that distributes imputation credits than on an otherwise identical firm that distributes no credits. [165]

Engagement

You are engaged by Jones Day on behalf of United Energy and Multinet Gas (UEMG) to provide the work (set out below). UEMG will be directly responsible for your invoices.

Please provide all invoices via email to Jeremy.Rothfield@ue.com.au and addressed to:

Jeremy Rothfield

Economist

United Energy and Multinet Gas

Level 1

Pinewood Corporate Centre

43-45 Centreway Place

Mount Waverley VICTORIA 3149

P.O. Box 449

Mount Waverley VICTORIA 3149

Copied to njtaylor@jonesday.com

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[165] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

While UEMG has a strong track record of making payments on time, no interest shall be payable in any circumstances.

Scope of work

NERA is asked to provide and review evidence on the value that the market places on imputation credits distributed. In particular, United Energy has asked NERA to:

- explain the methodology of Lajbcygier and Wheatley (2012) and of Siau, Sault and Warren (2015); [166]
- explain whether the results of these studies would be affected by higher-than-average trading volumes around ex-dividend dates;
- set out the advantages of the methodologies employed by Lajbcygier and Wheatley and of Siau, Sault and Warren relative to the use of aggregate ownership and tax statistics for the purposes of estimating the value of imputation credits; and
- update the results of the Lajbcygier and Wheatley and NERA (2013) studies and explain their relevance to estimating the value of imputation credits. [167]

United Energy has also asked NERA to respond to matters raised by the Australian Energy Regulator (AER) in its recently published *Draft decision, Jemena Gas Networks (NSW) Ltd, Access arrangement 2015-20* and in other recent AER decisions, and to address issues that Handley (2014) and Lally (2013, 2014) raise in reports written on behalf of the AER and the Queensland Competition Authority (QCA). [168]

Timeframe

The consultant should provide a final report by no later than 28th April, 2015.

Reporting

Jeremy Rothfield of UEMG will serve as the primary contact for the period of the engagement. The consultant will prepare reports showing the work-in-progress on a regular basis. The consultant will make periodic presentations on analysis and advice as appropriate.

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[166] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, *Are imputation credits capitalised in stock prices?* Accounting and Finance, March 2015, pages 241-277.

[167] NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[168] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

Handley, J., *Advice on the value of imputation credits*, University of Melbourne, 29 September 2014.

Lally, M., The estimation of gamma, Victoria University of Wellington, 25 November 2013.

Lally, M., *Review of submissions to the QCA on the MRP, risk-free rate and gamma*, 12 March 2014.

Conflicts

The consultant is to identify any current or potential future conflicts.

Compliance with the Code of Conduct for Expert Witnesses

Attached as **Annexure 1** is a copy of the Federal Court's Practice Note CM 7, entitled "Expert Witnesses in Proceedings in the Federal Court of Australia", which comprises the guidelines for expert witnesses in the Federal Court of Australia (Expert Witness Guidelines).

Please read and familiarise yourself with the Expert Witness Guidelines, and comply with them at all times over the course of your engagement with United Energy and Multinet Gas.

In particular, your report prepared for United Energy and Multinet Gas should contain a statement at the beginning of the report to the effect that the author of the report has read, understood and complied with the Expert Witness Guidelines.

Your report must also:

1. contain particulars of the training, study or experience by which the expert has acquired specialised knowledge;

2. identify the questions that the expert has been asked to address;

3. set out separately each of the factual findings or assumptions on which the expert's opinion is based;

4. set out each of the expert's opinions separately from the factual findings or assumptions;

5. set out the reasons for each of the expert's opinions; and

6. otherwise comply with the Expert Witness Guidelines.

The expert is also required to state that each of the expert's opinions is wholly or substantially based on the expert's specialised knowledge.

The declaration contained within the report should be that "[the expert] has made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the report".

Please also attach a copy of these terms of reference to the report.

Fees

The consultant is requested to submit:

- a fixed total fee for the project and hourly rates for the proposed project team should additional work be required; and
- details of the individuals who will provide the strategic analysis and advice.

Contacts

Any questions regarding this terms of reference should be directed to:

Nick Taylor (Jones Day)

Email: njtaylor@jonesday.com

Phone: 02 8272 0500

Kind regards

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Error! Use the Home tab to apply Author Title to the text that you want to appear here.

Appendix D. Federal Court Guidelines

FEDERAL COURT OF AUSTRALIA

Practice Note CM 7

EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the *Evidence Act 1995* (Cth)).

3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[169], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

1. General Duty to the Court[170]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

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[169] As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

[170] The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.

2. The Form of the Expert's Report[171]

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

(ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above[172]; and

(h) comply with the Practice Note.

2.2 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that* [the expert] *believes are desirable and appropriate and that no matters of significance that* [the expert] *regards as relevant have, to* [the expert's] *knowledge, been withheld from the Court*."

2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[173].

2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

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[171] Rule 23.13.

[172] See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

[173] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565

2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[174].

3. Experts' Conference

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP
Chief Justice
4 June 2013

[174] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565-566. See also Ormrod *"Scientific Evidence in Court"* [1968] Crim LR 240

Appendix E. Curriculum Vitae

Simon M. Wheatley

5 Maple Street
Blackburn VIC 3130
Tel: +61 3 9878 7985
E-mail: swhe4155@bigpond.net.au

Overview

Simon is a consultant and was until 2008 a Professor of Finance at the University of Melbourne. Since 2008, Simon has applied his finance expertise in investment management and consulting outside the university sector. Simon's interests and expertise are in individual portfolio choice theory, testing asset-pricing models and determining the extent to which returns are predictable. Prior to joining the University of Melbourne, Simon taught finance at the Universities of British Columbia, Chicago, New South Wales, Rochester and Washington.

Personal

Nationalities:	U.K. and U.S.
Permanent residency:	Australia

Employment

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

- Assistant Professor, Graduate School of Business, University of Washington, 1984-1993

Education

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

Publicly Available Reports

Empirical performance of Sharpe-Lintner and Black CAPMs: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, AusNet Services, CitiPower, Energex, Ergon Energy, Powercor, SA Power Networks, and United Energy, February 2015, http://jemena.com.au/Gas/Jemena/media/jemenagasnetworksmedia/community-engagement-document/our-revised-regulatory-proposal/Appendix%2007.08%20NERA%20Empirical%20performance%20of%20the%20Sharpe-Lintner%20and%20Black%20CAPMs%20-%2026%20Feb%2015.pdf

Historical estimates of the market risk premium: A report for Jemena Gas Networks, Jemena Electricity Networks, ActewAGL, Ausgrid, AusNet Services, Australian Gas Networks, CitiPower, Endeavour Energy, Energex, Ergon, Essential Energy, Powercor, SA Power Networks and United Energy, February 2015, http://jemena.com.au/Gas/Jemena/media/jemenagasnetworksmedia/community-engagement-document/our-revised-regulatory-proposal/Appendix%2007.07%20NERA%20Historical%20estimates%20of%20the%20MRP%20-%2013%20Feb%2015.pdf

Robust regression techniques: A report for DBP, December 2014, https://www.erawa.com.au/cproot/13287/2/Submission%2012%20-%20Appendix%20F%20-%20Robust%20Regression.PDF

Imputation Credits and Equity Returns: A report for the Energy Networks Association, October 2013, http://www.aer.gov.au/sites/default/files/ENA,%20Attachment%204%20-%20NERA%20Report%20-%20Imputation%20Credits%20and%20Equity%20Prices,%20Submission%20to%20draft%20AER%20rate%20of%20return%20guideline%20-%2011%20Oct%202013.pdf

The Fama-French Three-Factor Model: A report for the Energy Networks Association, October 2013, http://www.aer.gov.au/sites/default/files/Essential%20Energy%20-%20Attachment%207.9_NERA_The%20Fama-French%20Three-Factor%20Model%20-%202014.pdf

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%20The%20Market%20Risk%20Premiuml,%20Submission%20to%20draft%20AER%20rate%20of%20return%20guideline%20-%2011%20Oct%202013.pdf

The Market, Size and Value Premiums: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%2015%20-%20ENAMRPReport28062013%20Final.pdf

Estimates of the Zero-Beta Premium: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%202%20-%20Black%20CAPM%20Zero%20Beta%20Estimate%20(Final)%20-%2027%20June..pdf

The Payout Ratio: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%2012%20-%20Payout%20Ratio%20(Final)%20-%20June%202013.pdf

Review of Cost of Equity Models: A report for the Energy Networks Association, June 2013, http://www.aer.gov.au/sites/default/files/Report%201%20-%20Alternative%20Cost%20of%20Equity%20Models%20(Final)%20-%2026%20June.pdf

The Cost of Equity for a Regulated Energy Utility: A Response to the QCA Discussion Paper on the Risk-Free Rate and the MRP: A report for United Energy and Multinet Gas, March 2013, http://www.qca.org.au/files/CI-UEM-SubNERA-CCR1213-0413.pdf

The Cost of Equity for a Regulated Energy Utility: A report for Multinet, February 2013, http://www.erawa.com.au/cproot/11197/2/20130312%20-%20D103642%20-%20Guidelines%20for%20the%20Rate%20of%20Return%20for%20Gas%20Transmission%20and%20Distribution%20Networks%20-%20United%20Energy%20and%20Multinet%20Gas.pdf

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20of%20equity%20-%20Jemena%20-%20Sandra%20Gamble%20-%2022%20December%202009%20-%20APD%20-%20Website.PDF

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AER's Proposed WACC Statement – Gamma: A report for the Joint Industry Associations, 30 January 2009, http://www.aer.gov.au/content/item.phtml?itemId=726698&nodeId=80cf978278d317e99c34ae1878525573&fn=JIA%20Appendix%20Q%20-%20NERA%20-%20AER's%20proposed%20WACC%20statement-Gamma.pdf

The Value of Imputation Credits: A report for the ENA, Grid Australia and APIA, 11 September 2008, http://www.ena.asn.au/udocs/24092008aersub/Appendix%20K%20-%20The%20value%20of%20imputation%20credits%20-%20NERA.pdf

Consulting Experience

NERA, 2008-present

Lumina Foundation, Indianapolis, 2009

Industry Funds Management, 2010

Academic Publications

Imputation credits and equity returns, (with Paul Lajbcygier), 2012, *Economic Record* 88, 476-494.

Do measures of investor sentiment predict returns? (with Robert Neal), 1998, *Journal of Financial and Quantitative Analysis* 33, 523-547.

Adverse selection and bid-ask spreads: Evidence from closed-end funds (with Robert Neal), 1998, *Journal of Financial Markets* 1, 121-149.

Shifts in the interest-rate response to money announcements: What can we say about when they occur? (with V. Vance Roley), 1996, *Journal of Business and Economic Statistics* 14, 135-138.

International investment restrictions and closed-end country fund prices, (with Catherine Bonser-Neal, Greggory Brauer, and Robert Neal), 1990, *Journal of Finance* 45, 523-547 (reprinted in International Capital Markets Volume III, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).

A critique of latent variable tests of asset pricing models, 1989, *Journal of Financial Economics* 21, 177-212.

Some tests of international equity market integration, 1988, *Journal of Financial Economics* 21, 177-212 (reprinted in International Capital Markets Volume I, 2003, G. Andrew Karolyi and Rene M. Stulz, editors, Edward Elgar Publishing, Cheltenham, Glos).

Some tests of the consumption-based asset pricing model, 1988, *Journal of Monetary Economics* 22, 193-215.

Working Papers

An evaluation of some alternative models for pricing Australian stocks (with Paul Lajbcygier), 2009.

Intertemporal substitution, small-sample bias, and the behaviour of U.S. household consumption (with Kogulakrishnan Maheswaran and Robert Porter), 2007.

Keeping up with the Joneses, human capital, and the home-equity bias (with En Te Chen), 2003.

Evaluating asset pricing models, 1998.

Time-non-separable preferences or artifact of temporal aggregation? (with Robert Porter), 2002.

Testing asset pricing models with infrequently measured factors, 1989.

Refereeing Experience

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

Program Committee for the Western Finance Association in 1989 and 2000.

Teaching Experience

International Finance, Melbourne Business School, 2008

Corporate Finance, International Finance, Investments, University of Melbourne, 1999-2008

Corporate Finance, International Finance, Investments, Australian Graduate School of Management, 1994-1999

Investments, University of Chicago, 1993-1994

Investments, University of British Columbia, 1986

International Finance, Investments, University of Washington, 1984-1993

Investments, Macroeconomics, Statistics, University of Rochester, 1982

Accounting, 1981, Australian Graduate School of Management, 1981

Teaching Awards

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

Computing Skills

User of SAS since 1980. EViews, Excel, EXP, LaTex, Matlab, Powerpoint, Visual Basic. Familiar with the Australian School of Business, Compustat and CRSP databases. Some familiarity with Bloomberg, FactSet and IRESS.

Board Membership

Anglican Funds Committee, Melbourne, 2008-2011

Honours

Elected a member of Beta Gamma Sigma, June 1986.

Fellowships

Earhart Foundation Award, 1982-1983

University of Rochester Fellowship, 1979-1984

Simon Fraser University Fellowship, 1979

Inner London Education Authority Award, 1973-1977

Report qualifications/assumptions and limiting conditions

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29 April 2015

Partner
Nicolas Taylor
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TERMS OF REFERENCE
Do Imputation Credits Lower the Cost of Equity? Cross-Sectional Tests

Background

The Australian Energy Regulator (**AER**) is empowered to make five yearly regulatory determinations that control the aggregate average prices charged by regulated energy network businesses. The National Electricity Rules (**The Rules**) provide for a Regulated Asset Base (**RAB**) to be established and updated annually and for an operational expenditure allowance. A further key component of the regulatory determination is the allowed rate of return for debt and equity (or weighted average cost of capital) for funding the business. The principal Rules governing how the AER sets the allowed rate of return on debt for electricity distribution businesses are contained in Rule 6.5.2 of the National Electricity Rules (see attached). The same Rules in, essentially the same terms, apply to gas distribution businesses.

When the AER exercises the relevant regulatory powers under the National Electricity Rules, it is also required to apply section 16 of the National Electricity Law (see attached). Specifically, section 16 provides that '*the AER must, in performing or exercising an AER economic regulatory function or power – (a) perform or exercise that function or power in a manner that will or is likely to contribute to the achievement of the national electricity objective….*'That national electricity objective is set out in section 7 of the National Electricity Law as: '*The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to- (a) price, quality, safety, reliability and security of supply of electricity; and (b) the reliability, safety and security of the national electricity system.'*

Additionally the Rules require the AER to publish a Rate of Return Guideline which explains how the regulator intends to apply the Rules (attached). The AER has recently made a preliminary determination for Jemena Gas Networks applying the Rules (attached).

The National Electricity Rules require that the estimated cost of corporate income tax for a network service provider include a value for imputation credits, gamma.[1] Gamma represents the value that equity investors place on imputation credits created through the payment of company income tax and is generally estimated as the product of two elements:[2]

- The *payout* ratio, being the proportion of created credits distributed by companies to their shareholders; and
- *Theta*, the market value of distributed imputation credits as a proportion of their face value.

In the AER's post tax revenue model, the value of gamma is used to determine the proportion of the assumed company income tax that does not need to be included in a regulated firm's annual revenue requirement. The AER's framework presumes that imputation credits distributed lower the without-credit cost of equity. Put another way, the AER uses a framework that presumes that the market places a higher value on a firm that distributes imputation credits than on an otherwise identical firm that distributes no credits. Lajbcygier and Wheatley (2012) test the proposition that imputation credits distributed lower the without-credit cost of equity while Siau, Sault and Warren (2015) test the proposition that the market places a higher value on a firm that distributes imputation credits than on an otherwise identical firm that distributes no credits.[3]

Engagement

You are engaged by Jones Day on behalf of United Energy and Multinet Gas (**UEMG**) to provide the work (set out below). UEMG will be directly responsible for your invoices.

Please provide all invoices via email to Jeremy.Rothfield@ue.com.au and addressed to:

Jeremy Rothfield
Economist
United Energy and Multinet Gas
Level 1
Pinewood Corporate Centre
43-45 Centreway Place
Mount Waverley VICTORIA 3149

Copied to njtaylor@jonesday.com

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1 Australian Energy Market Commission, *National Electricity Rules Version 69*, page 661.

2 More specifically, the PTRM provides an allowance to a benchmark efficient entity for the costs of meeting corporate tax obligations. A higher value of gamma in the PTRM will imply that the model provides a lower allowance for the benchmark entity to satisfy its tax obligations. The "net tax allowance" is a component of the annual revenue requirement.

3 Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, Are imputation credits capitalised in stock prices? Accounting and Finance, March 2015, pages 241-277.

While UEMG has a strong track record of making payments on time, no interest shall be payable in any circumstances.

Scope of work

NERA is asked to provide and review evidence on the value that the market places on imputation credits distributed. In particular, UEMG has asked NERA to:

- Explain the methodology of Lajbcygier and Wheatley (2012) and of Siau, Sault and Warren (2015); [4]
- Explain whether the results of these studies would be affected by higher-than-average trading volumes around ex-dividend dates;
- Set out the advantages of the methodologies employed by Lajbcygier and Wheatley and of Siau, Sault and Warren relative to the use of aggregate ownership and tax statistics for the purposes of estimating the value of imputation credits; and
- Update the results of the Lajbcygier and Wheatley and NERA (2013) studies and explain their relevance to estimating the value of imputation credits. [5]

United Energy has also asked NERA to respond to matters raised by the Australian Energy Regulator (AER) in its recently published *Draft decision, Jemena Gas Networks (NSW) Ltd, Access arrangement 2015-20* and in other recent AER decisions, and to address issues that Handley (2014) and Lally (2013, 2014) raise in reports written on behalf of the AER and the Queensland Competition Authority. [6]

Timeframe

The consultant should provide a final report by no later than 29th April, 2015.

Reporting

Jeremy Rothfield of UEMG will serve as the primary contact for the period of the engagement. The consultant will prepare reports showing the work-in-progress on a regular basis. The consultant will make periodic presentations on analysis and advice as appropriate.

Conflicts

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[4] Lajbcygier , P. and S. M. Wheatley, *Imputation credits and equity returns*, Economic Record, 2012, pages 476-494.

Siau, K-W., S. Sault and G.J. Warren, *Are imputation credits capitalised in stock prices?* Accounting and Finance, March 2015, pages 241-277.

[5] NERA, *Imputation credits and equity prices and returns: A report for the Energy Networks Association*, October 2013.

[6] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015–20 Attachment 4 - Value of imputation credits*, November 2014.

Handley, J., *Advice on the value of imputation credits*, University of Melbourne, 29 September 2014.

Lally, M., The estimation of gamma, Victoria University of Wellington, 25 November 2013.

Lally, M., *Review of submissions to the QCA on the MRP, risk-free rate and gamma*, 12 March 2014.

The consultant is to identify any current or potential future conflicts.

Compliance with the Code of Conduct for Expert Witnesses

Attached as **Annexure 1** is a copy of the Federal Court's Practice Note CM 7, entitled "Expert Witnesses in Proceedings in the Federal Court of Australia", which comprises the guidelines for expert witnesses in the Federal Court of Australia (Expert Witness Guidelines).

Please read and familiarise yourself with the Expert Witness Guidelines, and comply with them at all times over the course of your engagement with United Energy and Multinet Gas.

In particular, your report prepared for United Energy and Multinet Gas should contain a statement at the beginning of the report to the effect that the author of the report has read, understood and complied with the Expert Witness Guidelines.

Your report must also:

1. Contain particulars of the training, study or experience by which the expert has acquired specialised knowledge;

2. Identify the questions that the expert has been asked to address;

3. Set out separately each of the factual findings or assumptions on which the expert's opinion is based;

4. Set out each of the expert's opinions separately from the factual findings or assumptions;

5. Set out the reasons for each of the expert's opinions; and

6. Otherwise comply with the Expert Witness Guidelines.

The expert is also required to state that each of the expert's opinions is wholly or substantially based on the expert's specialised knowledge.

The declaration contained within the report should be that "[the expert] has made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the report".

Please also attach a copy of these terms of reference to the report.

Fees

The consultant is requested to submit:

- A fixed total fee for the project and hourly rates for the proposed project team should additional work be required; and

- Details of the individuals who will provide the strategic analysis and advice.

Contacts

Any questions regarding this terms of reference should be directed to:

Nick Taylor (Jones Day)

Email: njtaylor@jonesday.com

Phone: 02 8272 0500

Kind regards

Nicolas Taylor

Partner

Annexure 1

FEDERAL COURT OF AUSTRALIA
Practice Note CM 7
EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see **Part 3.3 - Opinion** of the Evidence Act 1995 (Cth)).

3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[1], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

Guidelines

1. General Duty to the Court[2]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

2. The Form of the Expert's Report[3]

1 As to the distinction between expert opinion evidence and expert assistance see Evans Deakin Pty Ltd v Sebel Furniture Ltd [2003] FCA 171 per Allsop J at [676].

2 The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.

3 Rule 23.13.

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

(ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above[4]; and

(h) comply with the Practice Note.

2.2 At the end of the report the expert should declare that "[the expert] has made all the inquiries that [the expert] believes are desirable and appropriate and that no matters of significance that [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the Court."

2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[5].

2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[6].

3. Experts' Conference

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the

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4 See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.

5 The "Ikarian Reefer" [1993] 20 FSR 563 at 565

6 The "Ikarian Reefer" [1993] 20 FSR 563 at 565-566. See also Ormrod "Scientific Evidence in Court" [1968] Crim LR 240

Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP
Chief Justice
4 June 2013