THE ESTIMATION OF GAMMA

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EXECUTIVE SUMMARY

In August 2013 the AER released draft guidelines for the setting of WACC in future determinations. These guidelines include a method for estimating the value of gamma, of 0.50, constituting the product of a distribution rate of 0.7 and a utilisation rate (*U*) of 0.70. This paper seeks to critically review the AER's conclusions and to address a number of related questions posed by the AER relating to the definition of gamma, the role of foreign investors, and the use of data around dividend ex-days to estimate the utilisation rate. The conclusions are as follows.

In respect of *U*, there are five possible approaches to estimating it. The first of these arises from the definition of the parameter as a weighted average across all investors; coupled with ignoring foreigners (consistent with the Officer CAPM), this yields an estimate of 1 (the utilisation rate of local investors). The second possibility also arises from the definition of the parameter, but with recognition of foreigners, and leads to an estimate of about 0.70 (the proportion of Australian equities held by Australians). The third possibility is to use the proportion of credits that are redeemed with the Australian tax authority by all investors, and leads to an estimate of about 0.40 to 0.80, with a midpoint of 0.60. The fourth possibility is to use market prices, from cum and ex-dividend share prices, simultaneous share and futures prices, simultaneous share index and futures prices, and regressions of returns on imputation credit yields. Using results from post July 2000, and using the parameter estimates favoured by the authors where there is variation, the results are 0.40, 0.13, 0.64, and -2.00. If the last result is ignored, on the grounds of complete implausibility, the average is 0.39. The fifth possibility is to draw upon surveys of market practitioners, which reveals a trend towards explicit recognition of the credits, with the latest evidence suggesting a value for *U* of 0.75 amongst those who make explicit adjustments and the rest generally appear to believe that *U* is positive despite not making explicit adjustments. So, it does not produce a point estimate.

In my view, the most important requirements in selecting a methodology for estimating *U* are that the estimate be consistent with the definition of *U*, as a value-weighted average over the utilisation rates of all investors who are relevant to the Officer CAPM, that the parameter estimate is likely to give rise to an estimated cost of equity from the Officer model that lies within the bounds arising from either complete segmentation or complete integration of equity markets, and that the estimate is reasonably precise. The first approach described in the previous paragraph satisfies each of these requirements and is therefore recommended. The second approach described in the previous paragraph satisfies the third of these requirements, but not the first because it recognises foreign investors and not the second in the sense that its associated estimate of *U* would give rise to implausibly high costs of equity; it is therefore ranked second. The third approach (the proportion of credits redeemed with the tax authorities) is similar to the second but lacks its precision and therefore does not satisfy any of these requirements. The fourth approach (using market prices) does not satisfy any of these requirements, because it is not a value-weighted average over all investors, its estimate of *U* would give rise to implausibly high costs of equity, and the estimate is very imprecise in the sense that the approach generates a wide range of estimates depending upon the specific methodology and data used, the estimates from the dividend drop-off studies may also reflect broader anomalies unrelated to tax issues, it is exposed to the actions of a small and unrepresentative set of investors, and it is exposed to microstructure effects such as the bid-ask bounce. It also produces ancillary results relating to the valuation of cash dividends that are inconsistent with the Officer model. The fifth approach does not produce a point estimate. Using the three criteria described above, my preferred estimate is 1 from the first approach and my second preference is 0.70 from the second approach. If these three criteria were rejected, I would favour use of the results from the first four approaches, with values of 1, 0.70, 0.60, and 0.39; the problems associated with the third and fourth methods warrant a lower weighting than on the other methods and therefore an estimate for *U* of about 0.80.

In respect of the distribution rate, the various theory-based arguments (all for a distribution rate of 1) are not justified, and therefore an empirical estimate is warranted. Within the Officer model, the distribution rate is firm specific. However, the use of firm-specific estimates is ruled out by the resulting incentives of firms to manipulate their dividend levels. The choice then lies between an industry average and a market average. Industry averages are likely to be an ongoing source of contention, involving which firms to choose and how much historical data to use. These difficulties are absent from a market average but there is considerable variation in the rate across firms and therefore the market-wide average could be a poor indicator of the situation for any industry. So, the appropriate choice is not clear but I favour the market-wide average. Finally, since the relevant distribution rate is the expected future rate and historical data reveals that a significant proportion of credits have not been distributed, it might be argued that they eventually will be and therefore the expected future distribution rate must exceed the historical rate. However, there is no strong theoretical argument for eventual distribution and therefore historical experience must be favoured as an estimator for the future. Invoking the historical market-wide data, from both the ATO and from annual reports, this points to an estimate for the distribution rate of at least 70%.

Having offered estimates for U and the distribution rate, the estimate of gamma is the product of these. My preferred estimate for U is 1 from the first approach described above and, coupled with my estimate for the distribution rate of at least 0.70, yields an estimate for gamma of at least 0.70. My second preference in estimating U is 0.70 from the second approach described above and, coupled with my estimate for the distribution rate of at least 0.70, yields an estimate for gamma of at least 0.50. My third preference in estimating U is about 0.80, as described above, and, coupled with my estimate for the distribution rate of at least 0.70, yields an estimate for gamma of at least 0.56.

1. Introduction

In August 2013 the AER (2013) released draft guidelines for the setting of WACC in future determinations. These guidelines include a method for estimating the value of gamma, of 0.50, constituting the product of a distribution rate of 0.7 and a utilisation rate (U) of 0.70. This paper seeks to critically review the AER's conclusions and to address a number of related questions posed by the AER relating to the definition of gamma, the role of foreign investors, and the use of data around dividend ex-days to estimate the utilisation rate (see the Terms of Reference in Appendix 1).

2. Background

2.1 The Mechanics of Dividend Imputation

Consider a firm that generated taxable income of $10m, paid company tax of $3m (at the corporate tax rate of 30%), leaving $7m, and then paid a dividend of $4m. Prior to dividend imputation being adopted in Australia, the recipients of the dividends would have paid personal tax on the dividends in accordance with their marginal tax rate. So, if this was 35% for all such shareholders, the personal tax paid would have been 35% of $4m ($1.4m). Thus, two layers of tax are paid: company tax followed by personal tax when dividends are paid.

Dividend Imputation is designed to reduce the tax to only one layer, by treating company taxes that lie behind a dividend as a pre-payment of personal tax by companies on behalf of their shareholders. Crucial to this is to decide how much of the company taxes that have been paid ($3m in the above example) are associated with the dividend of $4m. Letting T_c denote the statutory company tax rate, Australian tax law allows the associated company tax to be as large as

$$DIV\left(\frac{T_c}{1-T_c}\right)$$

providing that company taxes of that amount have been paid. So, with a dividend of $4m and a corporate tax rate of 30%, the maximum company tax that is associated with the dividend would be $1.714m. Since this does not exceed the company taxes of $3m, the figure of $1.714m would be associated with the dividend and is then treated as a pre-payment of personal tax by the company on behalf of its shareholders. Accordingly, it is called an imputation credit.

These imputation credits may or may not be useable by shareholders to reduce their personal tax obligations. Suppose that half of the shareholders cannot use the credits and the rest can. For those who can't use the credits, and receive dividends of \$2m, their personal tax obligation would be 35% of \$2m (\$0.7m), and therefore a post-tax dividend of \$1.3m, as before. For those who can use the credits, and receive dividends of \$2m (and therefore imputation credits of \$0.857m), the personal tax obligation would be \$0.143m and their post-tax dividend would be \$1.857m, as follows:

Gross Dividend = Cash Dividend + Imputation Credits = \$2m + \$0.857m = \$2.857m
Tax on Gross Dividend = \$2.857m x 0.35 = \$1m
Tax Obligation = Tax on Gross Dividend – Imputation Credits = \$1m - \$0.857m = \$0.143m
Post tax Dividend = Cash Dividend – Personal Tax = \$2m - \$0.143m = \$1.857m

So, the effect of imputation is to reduce personal tax for the shareholders who can use the imputation credits from \$0.7m to \$0.143m, and therefore raise their post-tax dividend from \$1.3m to \$1.857m.

The entire pre-tax profit of \$10m can be categorised into the part that is paid in taxes, the part retained within the business, the part received as dividends net of taxes by shareholders who can't use the imputation credits, and the part received as dividends net of taxes by shareholders who can use the imputation credits, as shown in Table 1 below. Importantly, the total tax rate (total taxes divided by pre-tax income) paid in respect of income distributed as dividends to shareholders who can use the imputation credits is 35%, which is the personal tax rate of these shareholders. For shareholders who can use the credits, one interpretation of this is that company taxes have been augmented by personal taxes, to achieve a total tax rate of 35% comprising company tax at 30% and additional personal tax at 5%. An alternative interpretation is that, for these shareholders, company tax has been completely supplanted by personal tax at their personal tax rate of 35%.

Three other important features of this example are as follows. Firstly, the total company taxes paid are \$3m of which \$1.714m has been reclassified as imputation credits. The proportion here is 57%, and is generally called the "distribution rate" for the imputation credits. Secondly, the rest of these company taxes (\$1.286m) are called undistributed credits, and these might be attached to future dividends. Thirdly, of the imputation credits that have been attached to dividends (of $1.714m), half of these have been fully used by investors and the other half have been unused. Leaving aside the question of which investors are relevant, this proportion used (50%) is called the "utilisation rate".

Table 1: Allocation of Income and Associated Taxes

	Retained	To Sholders Not Using ICs	To Sholders Using ICs	Total
Pre-Tax Income	$4.286m	$2.857m	$2.857m	$10m
Company Tax at 30%	$1.286m	$0.857m	$0.857m	$3m
Post-Tax Profit	$3m	$2m	$2m	$7m
Dividend		$2m	$2m	$4m
Dividend Tax		$0.7m	$0.143m	$0.843m
Post-Tax Dividends		$1.3m	$1.857m	$3.157m
Total Tax Rate		54%	35%	38%

As noted this process can be interpreted in two equivalent ways. One interpretation is to consider shareholders who can use the credits to have paid personal taxes of $0.143m in addition to company taxes associated with their dividends of $0.857m, totalling $1m, as shown in the penultimate column of Table 1. The other interpretation is to consider the company taxes associated with these dividends as having been retrospectively set to zero and the entire taxes paid of $1m constituting personal taxes at the investor's marginal tax rate of 35% (applied to the gross dividend). In this latter case, the company taxes that have effectively been paid are reduced to $2.143m, representing 21.4% of the pre-tax income of $10m. This effective tax rate T_e of 21.4% is related to the statutory rate, the "distribution rate", and the "utilisation rate" as follows:

$$T_e = T_c\left[1 - U\,\frac{IC}{TAX}\right] = .30\left[1 - (.50)\,\frac{\$1.714m}{\$3m}\right] = 0.214$$

where *IC* is the imputation credits for that company in the relevant period, *TAX* the company taxes paid by it, and *U* the utilisation rate.

2.2 The Role of Imputation Credits in the Officer CAPM

The standard form of the CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966) assumes inter alia that all forms of income from capital assets are equally taxed at the personal level. Whether this is inconsistent with dividend imputation depends upon how imputation is interpreted. If it is interpreted as a process that reduces the tax rate on cash dividends, corresponding to the first interpretation discussed in the previous section, then the standard form of the CAPM cannot apply and therefore must be displaced by a version that recognises that cash dividends are taxed at a lower rate than ordinary income (as in Lally, 1992, and Cliffe and Marsden, 1992). By contrast, if imputation is interpreted as a process that substitutes personal tax for corporate tax, corresponding to the second interpretation discussed in the previous section, then the standard CAPM is still valid. However, as shown in the previous section, the dividend tax rate now applies to gross dividends (cash dividends plus imputation credits, to the extent the latter can be used) rather than cash dividends and therefore dividends within the context of the CAPM must be defined in the same way. This is the approach adopted by Officer (1994), and used by all Australian regulators. Thus the equilibrium expected rate of return on equity is

$$E(\hat{R}) = R_f + [E(\hat{R}_m) - R_f]\beta_e \tag{1}$$

where R_f is the risk free rate, β_e the equity beta defined against the Australian market index, and $E(\hat{R}_m)$ the expected rate of return on the Australian market portfolio inclusive of imputation credits to the extent they can be used. Letting S_m denote the current value of the market portfolio, IC_m the imputation credits on the assets included in the market portfolio, U the utilisation rate on the credits, and R_m the actual rate of return on the market portfolio excluding the imputation credits, then

$$\hat{R}_m = R_m + \frac{IC_m}{S_m}U \tag{2}$$

Thus, when estimating the MRP, it is necessary to add the last term in this equation. Furthermore, and consistent with classifying some company tax as personal tax on dividends, being the distributed imputation credits to the extent that they can be utilised by investors, the cash flows that are discounted to yield the equity value of the company are accordingly higher. Letting S_0 denote the current value of equity, S_1 the expected value in one year, Y_1 the expected cash flows over the first year to equity holders (net of all deductions except company taxes), TAX_1 the expected company taxes over the first year, d the proportion of these company taxes that are distributed as imputation credits, and IC_1 the distributed imputation credits over the first year, then S_0 is the present value of Y_1, S_1, and TAX_1 (net of that part distributed as imputation credits and utilised by investors), discounted using the Officer CAPM with the MRP denoted ϕ:

$$S_0 = \frac{Y_1 - TAX_1 + IC_1 U + S_1}{1 + R_f + \phi\beta_e}$$

$$= \frac{Y_1 - TAX_1 + U(TAX_1)d + S_1}{1 + R_f + \phi\beta_e}$$

$$= \frac{Y_1 - TAX_1(1 - Ud) + S_1}{1 + R_f + \phi\beta_e} \qquad (3)$$

Letting P_1 denote the expected taxable income in the first year, then TAX_1 is the product of P_1 and the statutory corporate tax rate T_c, and therefore S_0 is as follows:

$$S_0 = \frac{Y_1 - P_1 T_c (1 - Ud) + S_1}{1 + R_f + \phi\beta_e}$$

$$= \frac{Y_1 - P_1 T_e + S_1}{1 + R_f + \phi\beta_e}$$

where T_e is the effective corporate tax rate referred to in the previous section. So, relative to the standard form of the CAPM, the Officer CAPM and the associated cash flows requires three additional parameters: the ratio of market-level imputation credits to the value of the market portfolio (IC_m/S_m), the ratio of firm-level imputation credits to firm level company tax payments (IC/TAX) and the utilisation rate (U). The second of these parameters is called the "distribution rate" and the product of the last two is called "gamma". Our concern in this paper is with the distribution rate and the utilisation rate.

The utilisation rate referred to here is a market-level parameter, i.e., the same value applies to each firm. Individual investors also have utilisation rates: one for those who can fully use the credits and zero for those who can't. Consequently it might be presumed that *U* is some type of weighted average over investors. Although Officer (1994) provides no clarification on this matter, because his derivation of the model is intuitive rather than formal, Lally and van Zijl (2003, section 3) provide a formal derivation of a generalisation of Officer's model (with the Officer model being a special case), in which variation of utilisation rates across investors is recognised. In this derivation, they show that *U* is a complex weighted average over all investors holding risky assets, where the weights involve each investor's investment in risky assets and their risk aversion. Individual investors' levels of risk aversion are not observable. Accordingly it is necessary to (reasonably) act as if risk aversion is uncorrelated with utilisation rate at the investor level, in which case the weights reduce to investors' relative investments in risky assets, i.e., *U* is a value-weighted average over the utilisation rates of individual investors.

By contrast with *U*, the distribution rate is a firm-level parameter and the parameter varies across firms. Variation across firms arises from variation in the ratio of Australian company tax paid to Australian sourced 'profits', and variation in the ratio of cash dividends to 'profits'.[1] For example, a firm might generate 'profits' of \$4m, pay Australian company tax of \$1m and pay a dividend of \$3m. As discussed in the previous section, the attachment of credits is subject to the restriction that

$$IC \leq \min\left[TAX\,,\,DIV\left(\frac{T_c}{1-T_c}\right)\right] \leq \min\left[\$1m,\,\$1.29m\right] = \$1m$$

and this implies a maximum attachment of \$1m. Since there is no rationale for withholding imputation credits, this firm would be expected to attach the entire \$1m available credits to the dividend. The value of *IC*/*TAX* would then be 1. However, ceteris paribus, a rise in *TAX* will lead to *IC*/*TAX* dropping below 1 because the existing dividend will eventually not be large

[1] Profit is used here to mean some performance measure on which dividends are based rather than to mean taxable income. The obvious performance measure is accounting profit. Also, as indicated earlier, the Officer formula presumes that the operation being valued is Australian, and therefore any company taxes paid are Australian, which give rise to imputation credits. However an 'Australian' company might still have some foreign operations in which case some of its company tax payments are made to a foreign tax authority. These cannot be used as imputation credits.

enough to permit all company taxes to be attached as imputation credits. In the above example, this occurs once *TAX* exceeds \$1.29m, whereupon *IC*/*TAX* will be less than 1. Similarly, ceteris paribus, a drop in *DIV* will also lead to *IC*/*TAX* dropping below 1 because the dividend will eventually not be large enough to permit all company taxes to be attached as imputation credits. In the above example, this occurs once the dividend falls below \$2.33m, whereupon *IC*/*TAX* will be less than 1.

3. Estimating the Utilisation Rate

3.1 The Definition of U

The AER (2013, section 8.3.1, pp. 119-120) defines *U* as the weighted-average over the utilisation rates of all investors in the market, with the weights reflecting both value and risk aversion.[2] This fully accords with the relevant academic literature (Monkhouse, 1993, Lally and van Zijl, 2003). Since it is difficult to estimate differences across investors in their level of risk aversion, the AER treats *U* as a value-weighted average over investors. This implies that variations in risk aversion are uncorrelated with the ability to utilise the credits, and I concur with this simplification.

The ENA (2013, section 7.2) contests this, claims that *U* is the *value* of the tax credits, as in *market value*, and cites Officer (1994, page 1, page 4) in support of this.[3] However the word "value" is capable of being interpreted in many ways including "numerical value", which has no particular market value connotations. Furthermore, Officer also defines *U* as the "proportion of tax collected from the company which gives rise to the tax credit associated with a franked dividend" (ibid, page 4), which clearly is not a market value. Furthermore his paper confuses the utilisation rate with gamma, and there is no statement, let alone derivation, of how *U* is linked to the individual utilisation rates of investors. Such shortcomings are not present in Monkhouse (1993) or Lally and van Zijl (2003). In both of the latter papers, *U* arises in the derivation of the model as a weighted-average over the utilisation rates of individual investors; this is not a market value concept.

[2] The AER also refers to the representative investor. However this phrase is redundant. It is only required in models in which investors are treated as homogeneous. By contrast, most CAPMs (including those of Monkhouse, and Lally and van Zijl) recognise that investors are heterogenous.

[3] The ENA actually refers to gamma rather than *U* but, since the distribution rate is clearly not a market value concept, I interpret their references to the value of gamma to be references to the value of *U*. Consistent with this, the ENA (ibid, page 4) states that "Applying the results of the market-based evidence of the value of distributed imputation credits with accepted measures of the distribution rate, confirms the conclusion that gamma should be set at o.25."

The ENA (2013, section 7.1) cites numerous authors in support of defining *U* as the “value” of a distributed credit. However, as with Officer, it is not clear whether these authors are using the word “value” to mean “market value” or simply numerical value (as in “what value does this parameter take?”). Furthermore, regardless of how many authors believe *U* to be a market value concept, the arbiter is the academic literature from which the model arises. In the cases in which these papers are sufficiently precise to be definitive, they clearly reveal that *U* is not a market value concept.

The ENA (2013, section 4.1) also argues that defining *U* in the way proposed by the AER involves a cash flow concept, and this would be inconsistent with value definitions of all other WACC parameters. However, *U* is both a cash flow concept and a WACC parameter within the Officer model, as shown in equations (1), (2), and (3). In any event, its definition must accord with the literature from which it arises and this matches the definition invoked by the AER.

Vo et al (2013, page 5) argues that *U* is the *value* of a distributed credit and further asserts that even domestic investors would value franking credits less than their face value because they must incur risk, pay transaction costs, and sacrifice international diversification opportunities by purchasing Australian stocks with imputation credits. However, as revealed by the relevant academic literature, *U* is a weighted average of the utilisation rates of investors rather than the market value (per unit) of the distributed credits. The same point is made by McKenzie and Partington (2010, pp. 7-8).

The AER (2013, page 237) also defines the utilisation rate as the proportion of distributed credits that investors redeem. This is not correct; the redemption rate is merely an estimation method, and as noted by the AER (2013, section 8) may overestimate *U* because of short-term holdings of shares by investors purely in order to obtain the credits (tax arbitrage).

It should also be noted that *U* is a parameter in the Officer version of the CAPM, and this model (like the standard CAPM of Sharpe, 1964, Lintner, 1965, and Mossin, 1966) is a discrete-time version of the model, i.e., investors are assumed to choose portfolios based upon their probability distributions for returns over some future period, without also considering return distributions beyond that future point. This implies that the future period must be substantial, and therefore applications of the model typically treat this period as being at least one year. Thus *U* is a value-weighted average over investors holding risky assets over the next year or more rather than the next few days. Thus, even if the next few days involved a large number of dividend ex-days across companies and therefore the mix of investors holding risky assets within that period were unusual (for tax arbitrage or other reasons), it would not follow that the value of *U* would change in accordance with such short-term behaviour.

3.2 The Role of Foreign Investors

The AER (2013, section 8.3.1, page 120) also includes foreign investors to the extent that they invest in the Australian market, to reflect the empirical reality of their existence. However this involves use of a model (the Officer CAPM) that assumes that national markets for risky assets are segmented along with the definition for a parameter (*U*) that is inconsistent with this model. Expressed more technically, the Officer model arises from the portfolio choices of a group of investors whose portfolio choices are limited to the Australian risk free asset (whose rate is determined exogenously) and Australian risky assets, and their portfolio choices determine the prices and hence the expected rates of return on these risky assets. Thus foreign investors, who by definition can hold both Australian and foreign risky assets, have no place in such a model. In addition, if Australian investors have access to foreign assets, the appropriate CAPM will reflect that fact and the equilibrium prices of Australian assets will differ. The ENA (2013, section 7.4.6) makes the same point.

By contrast, Handley (2008, section 2.2) appears to believe that there is no inconsistency and believes that all CAPMs start by defining the “market”, from which the “relevant” set of investors follows. Thus, if the market is Australian equities, then the relevant set of investors includes foreigners to the extent they invest in Australian equities. I do not agree. CAPMs do not start with a definition of the “market” but a set of assumptions about investor behaviour and institutional features, and the particular assumptions imply which market portfolio and set of investors are relevant. Some versions of the CAPM (such as Officer, 1994) assume complete segmentation of equity markets, in which case the relevant investors are Australian residents and the relevant market portfolio is all Australian risky assets (assets that can be purchased by Australian residents in a world in which there is complete segmentation of risky asset markets). Other versions of the CAPM assume complete integration (such as Solnik, 1974), in which case the relevant investors are those throughout the world and the relevant market portfolio would be all risky assets throughout the world.[4] Whichever version one chooses, one must then choose a proxy for the market portfolio, but this is only an implementation issue. Thus, for the Officer model, one might choose an Australian equity index whilst, for the Solnik model, one might choose a world equity index.

The fact that the market proxy for the Officer model comprises assets that are in part held by foreigners does not make those foreigners "relevant" to the model. They are simply a manifestation of the fact that the model is not entirely realistic, i.e., they would not exist if the model's assumption of segmentation were correct. Similarly, one might develop a model for the operation of gravity in a vacuum and then apply it to situations that are not vacuums; the empirical fact of friction will then conflict with the model but friction does not thereby become part of the model. In both cases, the ideal course of action is to build a model that reflects all empirical features. If this cannot be done, some error is inevitable. The question then is how best to deal with the problem; the problem cannot be waved away by merely defining things that are inconsistent with the model to be "relevant".

In addition to this conceptual conflict between the definition of a parameter and the underlying assumptions of the model, such an approach to defining U has a potentially perverse effect upon the estimated cost of equity. In particular, as national equity markets become increasingly integrated, foreign ownership of Australian equities will rise, and any estimate of U that is consistent with its definition will fall. If this has the effect of *raising* the estimated cost of equity capital using the Officer model and the true cost of equity actually *falls* as markets become more integrated (because investors will be holding more well diversified portfolios) then the effect of defining U to include foreign investors will be entirely perverse. This potential problem arises from combining a CAPM that assumes complete segmentation of equity markets with an estimate of U that reflects the actual degree of integration. This issue will be discussed further in section 3.9.

3.3: The Equity Ownership Approach

[4] The assumption of integrated markets is made explicitly by Solnik, being his assumption A-7 that there are no constraints on international capital flows (ibid, page 502). By contrast, the assumption of segmentation in models such as Officer and Sharpe is implicit in the fact that investors are assumed to have the same perceptions about the expected returns on risky assets and no assumptions are made about exchange rates (Sharpe, 1964, pp. 433-434). Markets must then be segmented because otherwise (floating) exchange rates would in general preclude investors in different countries having the same beliefs about the expected rates of return on a given asset.

In respect of estimating *U*, the AER draws upon three principal methods. The first of these is the equity ownership approach, in which *U* is estimated as the proportion of Australian shares held by Australians (AER, 2013, section 8, pp. 120-131). Since *U* is a value-weighted average over investors, and the AER includes foreigners in this set, and foreigners can't use the credits (except through tax arbitrage, which is heavily constrained by legislation), and virtually all local investors can fully utilise them, it follows that *U* is the proportion of Australian shares held by Australians. Drawing upon data from the Australian Bureau of Statistics (2007), the estimate is 70%. With the inclusion of foreigners in the relevant set of investors, this methodology for estimating *U* follows directly from the AER's definition of *U*.

The AER considers that this approach may underestimate *U* because local investors are more likely to hold assets with high imputation credits. I disagree; the clientele effect to which the AER refers is likely to prevail but it has no implications for the question of whether the proportion of equities held by local investors is a good estimate of *U* when *U* is defined to include these investors. To see this point, suppose that local investors (who can fully utilise imputation credits) hold 70% of the value of Australian risky assets, foreigners (who cannot use the credits) hold the rest, 80% of companies pay dividends with imputation credits, and the rest do not. In this case, it follows from the definition of *U* that it will be 70%. Nevertheless, local investors may tend to hold the companies that pay imputation credits and foreigners may tend to hold the companies that don't pay imputation credits.

The more fundamental issue with this approach is that the estimate for *U* is influenced by the level of foreign investors and this is conceptually inconsistent with the use of a model (the Officer CAPM) that assumes that national markets for risky assets are segmented. However, pragmatically, the partial recognition of foreigners through the estimate of *U* might be desirable in the sense of mitigating the fact that the Officer model wrongly assumes that national markets for risky assets are segmented. This question is assessed in section 3.9.

3.4 The Imputation Credit Redemption Rate

The AER's second approach to estimating *U* involves the proportion of distributed imputation credits that are redeemed with the ATO (AER, 2013, pp. 131-133, 237-239). As (reasonably) noted by the AER, this approach is very similar to the equity ownership approach, differing primarily in that the redemption rate is likely to be driven above the proportion of shares held (generally) by Australian investors by those investors who have traded specifically to receive the credits (tax arbitrage). The AER cites estimates by Hathaway and Officer (2004), Handley and Maheswaran (2008, Table 4), and Hathaway (2010), with results ranging from 0.45 to 0.81. The AER (reasonably) assigns low weight to the results from the first study because its data is almost entirely drawn from before 2000 (when rebates for unused credits became available, and which could be presumed to raise the value of *U*). They conclude with an estimate for *U* of about 0.70.

Given that the AER (reasonably) assigns low weight to the results from Hathaway and Officer (2004), because its data is almost entirely drawn from before 2000, they ought to have taken the same view about the results from Handley and Maheswaran (2008) for the period 1988-2000. This leaves only two of their estimates based upon data since the tax regime change: 0.81 from Handley and Maheswaran (2008) for the period 2000-2004 and 0.65 from Hathaway (2010) for the period 2004-2008. More recently, using data from 2004-2011, Hathaway (2013, section 1.3) estimates this proportion at 0.62 or 0.44, with the variation arising from two possible approaches whose data cannot be reconciled. In view of the latter problem, the earlier estimate of 0.81 from Handley and Maheswaran would seem to be preferable. However, Hathaway (2010, page v) emphasis that he used data from 2004 because of concerns about the reliability of the earlier data. Thus the best that can be said of all this is that the redemption rate is uncertain, with recent estimates from 0.44 to 0.81.

As with the "equity ownership" approach, estimates of this type reflect the presence of foreigners and therefore will be conceptually inconsistent with the use of the Officer CAPM, which assumes complete segmentation of risky asset markets. In addition, even if recognition of foreigners were warranted, tax arbitrage by investors would give rise to an estimate of the utilisation rate from this approach that was inconsistent with its definition as a value-weighted average over investors. For example, if local investors temporarily hold shares around ex-dividend days (notwithstanding legislative rules designed to discourage this), the estimate of the utilisation rate using this approach will over-weight the impact of domestic investors in the definition of the utilisation rate, and therefore overestimate the utilisation rate relative to the (AER's) definition of it. However the legislative rules that discourage such behaviour are extensive and are likely to have significantly constrained such activity.[5] Consistent with this,

[5] These rules comprise the "holding period rule" (requiring investors who can utilize the credits to hold the shares for at least 45 days around the dividend ex-day as a condition of receiving the benefit from the credits), the 30% delta rule (requiring investors who can utilize the credits and hold shares around the dividend ex-day to be at least

the estimate of 81% from Handley and Maheswaren (2008) is not dramatically different to the estimate of 70% obtained in section 3.3 nor is the higher of Hathaway's (2013) two estimates (62%).

SFG (2012, pp. 7-8) argues that redemption rates for imputation credits provide an upper bound on *U* rather than a point estimate. Thus, if 80% of investors redeem these credits, the value of *U* is up to 80% rather than 80%. SFG argue that redemption rates merely indicate that the investors who redeem the dividends place *some* value on them, and this could be less than 100%. Such a claim is reasonable when applied to redemptions in general, but not with respect to imputation credits because those who redeem them can fully use them. To illustrate this point, let u_i denote the utilisation rate of investor *i* and t_i denote their marginal personal tax rate. Accordingly, the personal tax obligation of that investor, beyond the taxes already paid by the company, is as follows:

$$TAX_i = (DIV + u_i IC)t_i - u_i IC$$

Australian investors comprise two distinct groups: those who can legally use the credits and those who can't. For those who can legally use the credits, their tax calculation is as follows:

$$TAX_i = (DIV + IC)t_i - IC$$

Thus, for these investors, $u_i = 1$ rather than something between 0 and 1. For investors who can't legally use the credits, $u_i = 0$. Furthermore the utilisation rate *U* that appears in the Officer CAPM is a weighted average over the utilisation rates of individual investors and, as discussed in section 2.2, these weights are value weights. Thus, if investors who can legally use the credits hold risky assets of $200b and those who can't legally use the credits hold assets of $100b then

$$U = .67(1) + .33(0) = .67$$

30% exposed to movements in the stock as a condition of receiving the benefit from the credits), and the "related payments rule" (proscribing certain classes of transactions between investors who can and cannot utilize the credits), as discussed in Beggs and Skeels (2006, Appendix A).

Furthermore the value weight on the first investor group should be approximately equal to the proportion of dividends received, and this in turn should be approximately equal to the proportion of credits that are received. Assuming (reasonably) that the first investor group redeems all of their credits then the redemption rate would be equal to 0.67 and therefore would provide an accurate estimate of *U*.

This discussion presumes that investors who can't use the credits are unable to transfer them to others who can, and share the benefits with them. However, McKenzie and Partington (2011, page 9) argue that the legislative rules designed to prevent this can be overcome in some cases. For example, suppose as above that the value weight on investors who can legally use the credits (and do so) is 67% and the value weight on the others is 33%, in which case $U = 0.67$. However suppose that one third of the latter group temporarily transfers ownership of the shares to another party who can and does use the credits. In this case we would expect to see a redemption rate of 78%, which would overestimate *U*. Thus I agree with SFG that the redemption rate is likely to overestimate *U* but due to tax arbitrage rather than because those who can use the credits have a utilisation rate of less than 1. However, as discussed above, the legislative rules that discourage tax arbitrage are extensive and are likely to have significantly constrained such activity.

NERA (2013b, section 2.4) argues that redemption rates do not provide a reliable estimate of *U*. In support of this, they consider a scenario in which there are no barriers to international investment (apart from the inability of foreign investors to redeem imputation credits) and find that the market value of the credits is trivial despite all of them being redeemed (because domestic investors hold all domestic risky assets). Thus, in a situation in which an international version of the CAPM would be appropriate, they find that imputation credits have little value and therefore local investors tilt towards local risky assets (causing all credits to be redeemed). Such a result is entirely sensible but tells us nothing about how one should estimate *U* in the present situation, in which capital markets are at least partly integrated and yet the cost of equity capital is estimated by a regulator using a version of the CAPM that (wrongly) assumes that national markets for risky assets are completely segregated. This conceptual mismatch is the fundamental problem, and it gives rise to a fundamental question: if capital markets are at least partly integrated and yet the cost of equity capital is estimated by a regulator using a version of the CAPM that (wrongly) assumes that national markets for risky assets are completely segregated, which methodology for estimating *U* is most appropriate?

3.5 The Use of Market Prices

The AER's third approach to estimating *U* involves estimates derived from market prices (AER, 2013, pp. 133-134, 239-247). The AER does not consider that these estimates are useful for a number of reasons. In respect of dividend drop-off studies, these include evidence that trading activity around dividend ex-days is abnormal, that correction is required for market movements, and the sensitivity of results to data, outliers and model choices. More generally these problems include the difficulties in separating the values of franking credits and dividends in these studies, the wide range of empirical results from such studies, the possibility of bias from 'bid-ask bounce, and the exposure of such estimates to the tax circumstances and transactions costs of tax arbitrageurs. Many of these problems are manifest in high standard errors on the estimates of the coefficients.

I concur with all of these concerns, and I have additional concerns about these studies or their interpretation. Firstly, all of these studies also suggest that unfranked dividends are taxed more heavily than capital gains, this tax differential is inconsistent with the Officer model, and it raises significant concerns about using any of these estimates of *U* in conjunction with the Officer CAPM. Secondly, estimates from these studies are likely to reflect the presence of foreigners and therefore would be inconsistent with the use of a CAPM that assumes complete segmentation of risky asset markets. Thirdly, the usual practice is to interpret the coefficient on franking credits that arises from these studies as *U*; however, this is not correct, and the result is to underestimate both *U* and its standard error. To demonstrate this, suppose that a dividend drop-off study involves the following regression:

$$P_{it-1} - P_{it}^{*} = \delta D_i + \theta FC_i + u_i \qquad (4)$$

where P_{it-1} is the cum-dividend price, P_{it}^{*} is the ex-dividend price corrected for the market movement, D_i is the cash dividend, FC_i is the franking credit, and u_i is the regression residual. Furthermore, there is no distinction between a cash dividend and a franking credit to the extent that the latter can be used. For example, if a franking credit can be fully used, a cash dividend of \$10 plus a franking credit of \$2 is as good as a cash dividend of \$12; in both cases, the gross dividend is \$12 and the investor's post-tax dividend is \$12(1 – *t*) where *t* is their marginal ordinary tax rate. If all investors could fully utilise the credits, the regression model should then be framed as

$$P_{it-1} - P_{it}^{*} = \delta[D_i + FC_i] + u_i \tag{5}$$

where δ would recognise that the expected price change might differ from the gross dividend (because the tax rate on gross dividends differs from that on capital gains for many investors). However some investors cannot use the credits at all and this should be dealt with by multiplying *FC* by a coefficient *U* that represented some kind of average utilisation rate. Equation (5) would then become

$$\begin{aligned} P_{it-1} - P_{it}^{*} &= \delta[D_i + U(FC_i)] + u_i \\ &= \delta(D_i) + \delta U(FC_i) + u_i \end{aligned} \tag{6}$$

Comparison of equation (6) with equation (4) above then reveals that $\theta = U\delta$ rather than $\theta = U$. This distinction is also recognised by Handley (2008, page 11). To illustrate the effect here, SFG (2013a, para 85) conclude with an estimate of 0.85-0.90 for δ and 0.35 for θ, and they equate the latter with *U*. However, since $\theta = \delta U$, the implied estimate for *U* is 0.35/0.875 = 0.40 rather than 0.35. Even more significantly, Beggs and Skeels (2006, Table 5) estimate δ at 0.80 and θ at 0.57 for 2000-2004, which implies that *U* is 0.57/0.80 = 0.72 rather than 0.57.

Reverting to the concerns raised by the AER, many of them warrant clarification or amplification. Firstly, whilst the AER (2013, Table K.14) presents the results from many of these studies, it should be noted that those based upon data since July 2000 (when cash rebates for unused distributed credits became available) are the most important, and the same point is made by the ENA (2013, page 53). The principal such studies are SFG (2013a), Cummings and Frino (2008), SFG (2013b), and NERA (2013b).[6] SFG (2013a) is a dividend drop-off study (Method 1), using data from 2001-2013, and estimates *U* at 0.40 as described in the last

[6] Subject to two exceptions, these four studies are all those that present results using data since July 2000, and involve data for multiple companies or an index, and are either published or were submitted to the AER. The first of these exceptions is Vo et al (2013), who present results for the period since July 2000 but their study is effectively a sensitivity test on aspects of the SFG (2013a) study and will be discussed shortly. The other exception is Beggs and Skeels (2006, Table 5), who also present results for the period since July 2000 but their data covers a much shorter period than for SFG (2013a) and therefore their study is dominated by the SFG study.

paragraph. Cummings and Frino (2008) use contemporaneous prices for a share index and futures contracts over that index (Method 2), with data from 2002-2005, and estimate the utilisation rate at 0.65 and 0.63 from two different specifications, with an average of 0.64.[7] SFG (2013b) use contemporaneous prices for shares and futures contracts over those shares (Method 3), with data from 2000-2013, and estimate the utilisation rate at 0.13.[8] NERA (2013b, section 3) regress returns on the imputation credit yield and various control variables (Method 4), using data from 2000-2012, and estimate the utilisation rate at -2.00 (ibid, Table 3.5).[9] Thus, over these four studies, each of which uses market price data from the period to which the current tax regime relates, the estimates of U range from -2.00 to 0.64.

Secondly, although results using data prior to July 2000 are of much less interest as estimates of the current value of U, they also reveal a wide range in results for each period in which the tax regime is fixed. In particular, we examine some studies using data within the period August 1991 to May 1997, and May 1997 to July 1999.[10] In the first period, using contemporaneous cum and ex-div prices (Method 5), Walker and Partington (1999) estimate U at 0.88 (ibid, page 293). Also, in both the first and second periods, and using contemporaneous prices for shares and futures contracts over shares (Method 3), Cannavan et al (2004) estimate U at 0.16 in the first period and -0.06 in the second period (ibid, Table 3).[11] Also, in both the first and second periods, and using a dividend drop-off methodology (Method 1), Beggs and Skeels (2006,

[7] As before, these estimates are the coefficient on imputation credits divided by the coefficient on cash dividends. Thus, for the results shown in their Table 2, the calculation is 0.52/0.80 = 0.65. For the results shown in their Table 4, the calculation is 0.54/0.86 = 0.63.

[8] As before, this estimate is the coefficient on imputation credits divided by the coefficient on cash dividends. Thus, using the results shown in their Table 3, the calculation is 0.12/0.94 = 0.13.

[9] As before, this estimate is the coefficient on imputation credits divided by the coefficient on cash dividends. The latter figure is not given in Table 3.5 for the period 2000-2012 but is given in Table 3.4 for a longer period. The 'penalty' on dividends there is .05, which implies a dividend value relative to capital gains of 0.95. Thus, the estimate of U is -1.90/0.95 = -2.00. In addition, the parameter estimates used are for "portfolios" rather than "securities" because portfolios mitigate errors in estimating the values of variables used in the regression.

[10] August 1991 and May 1997 represent dates on which distinct restrictions on the use of imputation credits took effect whilst July 1999 represents the date on which capital gains taxes were reduced (Beggs and Skeels, 2006, Appendix I). These studies are all those that are published, and involve data for multiple companies or an index, and present results based upon data for either or both of the two periods referred to.

[11] As before, the coefficients on imputation credits (0.16 and -0.06 respectively) are divided by the coefficient on cash dividends (0.95), to yield the estimates of U.

Table 5) estimate U at 0.23 for the first period and 0.53 for the second period.[12] All of these results are shown in Table 2.

Table 2: Comparison of Market-Based Estimates of the Utilisation Rate

	Aug 91 - May 97	May 97 – July 99	July 00 – Oct 13
Method 1: Beggs and Skeels	0.23	0.53	
Method 1: SFG (2013a)			0.40
Method 2: Cummings and Frino			0.64
Method 3: Cannavan et al	0.15	-0.06	
Method 3: SFG (2013b)			0.13
Method 4: NERA			-2.00
Method 5: Walker and Partington	0.88		

Thus, over the period August 1991 to May 1997, the estimates for U range from 0.15 to 0.88 across three different methods, each of which uses market data. In addition, over the period July 1997 to July 1999, the estimates range from -0.06 to 0.53 across two different methods, each of which also uses market data. Finally, over the period since July 2000, the estimates range from -2.00 to 0.64 across four different methods, each of which also uses market data. For each of these three periods, the variation in results is so great as to damage the credibility of all such estimates. Furthermore, the variation over time in results from the same methodology exhibits no consistent pattern. In particular, for method 3, the estimate falls and then rises, which is consistent with an adverse tax change in July 1997 (the 45 day rule) and a favourable tax change in July 2000 (the tax rebate on unused credits). Unsurprisingly, both Cannavan et al (2004) and Cummings and Frino (2008) note this in support of their estimates. However, for method 1, the pattern is the opposite, with the estimate rising and then falling. The lack of a consistent pattern again damages the credibility of all such estimates.

Thirdly, much of this cross-sectional and inter-temporal variation in results is simply a reflection of the statistical uncertainty that pervades all econometric work, and this arises from

[12] As before, these estimates are the coefficient on imputation credits divided by the coefficient on cash dividends. Thus, for 1991-1997, the calculation is 0.201/0.861 = 0.23.

'noise' in the data (due to bid-ask bounce and to unrelated price movements over the cum to ex-day interval, aggravated by the high correlation between franking credits and the cash dividend which makes it difficult to identify the impact of only the credits on market prices even if the aggregate effect were clear).[13] For example, considering the first two estimates of *U* shown in Table 2 above, the standard errors on the estimates for SFG (2013a) and Cummings and Frino (2008) are at least 0.09 and 0.12 respectively, and more likely about 0.12 and 0.16 respectively.[14] Assuming that the two point estimates of *U* are uncorrelated, which is reasonable in view of the difference in the type of data used, the standard error on the difference in them would be 0.20, and therefore the difference in the point estimates of *U* (0.40 versus 0.64) is only 1.2 standard errors. This is well within the bounds of chance.

Fourthly, despite using the same methodology and data filtering rules to data from an almost identical period (July 2001 to July 2012 versus July 2001 to October 2012), Vo et al (2013) and SFG (2013a) generate some quite dramatic differences in results. In particular, for models 3 and 4 with OLS, SFG estimate *U* at 0.15 and 0.33 respectively whilst Vo et al estimates it at 0.60 and -0.08 respectively. In addition Vo et al's standard errors on the franking credit coefficient are on average 50% larger than SFG's. In addition, using different (but reasonable) approaches to investigating the effect of removing outliers, the effect on the parameter estimates is quite different. For example, in respect of SFG's preferred approach involving model 4 and "robust regression", the effect on Vo et al's estimate of the franking credit coefficient from progressively removing the 30 most extreme observations (in absolute terms), and rerunning the model after each deletion, is to generate estimates of this coefficient that (largely) progressively increase from 0.32 to 0.53 (ibid, Table 8 and Figure 15). The associated coefficients on cash dividends are not given but it could be presumed that the range in estimates for *U* would be at least as great as that for the coefficient on franking credits. Importantly, these 30 observations represent less than 1% of the total set of observations. By contrast, SFG progressively remove the 20 most extreme pairs of observations (the one that exerts the most

[13] McKenzie and Partington (2010, page 44) note that the correlation between the cash dividend and the franking credit in the SFG analysis is 70%.

[14] The reported standard error for SFG (2013a) is the average over those reported for their estimates of the coefficient on franking credits shown in their Tables 2 and 3, and the reported standard error for Cummings and Frino (2008) is the average over those reported for the coefficient on franking credits in their Tables 2 and 4. However, since we need standard errors for the estimated values of *U*, a correction is required for this. Lally (2005, section 5) undertakes this correction for results presented by Christensen (2004), and finds that the adjustments are 50% upwards for one period and 10% for another. Using the mean adjustment, of 30%, the standard errors for SFG (2013a) and Cummings and Frino (2008) would then be 0.12 and 0.16.

upward effect on the franking credit coefficient and the one exerting the most downward effect) and find only trivial effect on the coefficient (SFG, 2013a, Figure 4).[15] The ENA (2013, section 7.8.5) comments on both studies and notes (correctly) that they produce similar results for SFG's preferred approach of model 4 with robust regression. The ENA (ibid, section 7.11) also reproduces results from SFG (2011), which show the stability of their estimates in response to deleting outliers. However, the ENA ignores all differences between the SFG and Vo et al studies, and these differences undermine the credibility of results from all such studies.

Fifthly, and in respect of the robust regression models used by both SFG and Vo et al, the latter authors rerun the models with various values of the "tuning constant" in the model, and obtain significantly different estimates of the coefficient on franking credits across the range of values for the tuning coefficient, for each of SFG's four models. For example, in respect of SFG's model 4, the estimated coefficient varies from 0.32 to 0.64 (Vo et al, 2013, Table 11 and Figure 19).[16] Again, the associated coefficients on cash dividends are not given but it could be presumed that the range in estimates for *U* would be at least as great as that for the coefficient on franking credits.

Sixthly, 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 and the same applies to the NERA results.

Seventhly, many of these studies are subject to the question of whether to include a constant in their regression model. However the case for doing so is not clear cut and omission of the constant could materially alter the estimate for the utilisation rate.

[15] Vo et al also present results without the market adjustment on the ex-dividend price, as shown in equation (4). However, as noted by the ENA (2013, section 7.8.5), the estimates from such an approach are likely to be biased.

[16] Table 11 is actually labelled Table 8, but should be labelled Table 11.

Eighthly, all such studies must adopt rules for selecting observations, the choice is both subjective and it may materially alter the result. For example, in respect of SFG (2013a), they delete observations from companies with a market cap below 0.03% of the market index. Since observations are also (sensibly) eliminated if trades are not present on both the cum and ex-dividend dates, this company size rule has no clear incremental value. Furthermore, the choice of 0.03% is highly arbitrary; the rule tends to exclude observations that are least likely to be contaminated by tax arbitrage (the best ones), and the rule may have significantly biased SFG's results.

Ninthly, all such studies require some choice about the statistical model, the optimal choice is usually unclear and the choice could materially affect the result. For example, SFG (2013) present results from eight different approaches, yielding estimates of *U* that range from 0.17 to 0.46. Vo et al (2013) follow the same process and obtain results for the same eight approaches that vary from -0.08 to 0.60.

Tenthly, although the utilisation rate is a value-weighted average over all investors in the market, the use of market prices will produce an estimate that reflects the tax position, transactions costs and motives of those investors who transact at the relevant times (such as tax arbitrageurs) and these investors may be quite unrepresentative of the entire market. Furthermore, fully franked dividends and unfranked dividends may attract attention from quite different sets of arbitrageurs and therefore the difference in market prices across these two types of dividends may reflect (or partly reflect) the difference in the arbitrageurs rather than the valuation placed on the credits by the same group of investors. This tax-arbitrage argument was first presented by Kalay (1982) and it has a number of testable implications. In particular, trading volume will be higher around ex-dividend days, it will be positively related to dividend yield and it will be negatively related to transactions costs. These predictions have all been confirmed in the US by Lakonishok and Vermaelen (1986) and Michaely and Vila (1996); the latter show that volume is twice the normal level in the 11 days around ex-day for stocks in general and 17 times normal volume for stocks with high dividend yields and low transaction costs (ibid, pp. 481-485).

Further testable implications relate to abnormal returns on ex-dividend days: these abnormal returns will change if transactions costs significantly change and they will be related to the tax rates to which tax arbitragers are subject. Naranjo et al (2000) test these predictions by examining the ex-dividend day returns for US stocks with very high dividend yields and other features that facilitate tax arbitrage, they find that the returns shift from positive in the 20 years preceding the 1975 introduction of negotiated commissions to negative in the following 20 years, and they attribute this to tax arbitrage after 1975 by corporates (who face lower taxation on dividends than on capital gains). They also found that the post 1975 ex-dividend day returns are negatively related to the tax advantage of dividends over capital gains for corporates, consistent with tax arbitrage by corporates. Eades et al (1984) also find negative ex-day returns for preferred stock, which have high dividend yields. These negative ex-day returns for high dividend yield stocks are particularly interesting because they are consistent with ex-dividend day returns being driven by a subset of investors (corporate) that constitute only about 1% of the US market (Berk and DeMarzo, 2007, page 547).

Lastly, many dividend drop-off studies have identified various anomalies that cannot be attributed to any kind of tax explanation and this raises the possibility that ex-day behaviour is part of these broader anomalies. For example, Woolridge (1983), Grinblatt et al (1984) and Eades et al (1984) find abnormal returns on the ex-days for share splits and stock dividends for US stocks despite these events having no tax implications. In addition, Eades et al (1984) also find that excess returns on US stocks are abnormal for several days before and after dividend ex-day as well as on ex-day. Brown and Walter (1986, Table 3) find similarly anomalous behaviour in Australia. In relation to the ex-day results for share splits, Copeland et al (2005, page 666) comment that "..there is no explanation for the abnormally positive split ex-date returns..". In relation to the abnormal returns before and after dividend ex-days, Copeland et al (2005, page 666) also comment that "No good explanation for this result has yet been proposed." In respect of markets without taxes on dividends or capital gains, many studies still find positive abnormal returns on dividend ex-days: Frank and Jagannathan (1998) for Hong Kong, Milonas and Travlos (2001) for Greece, and Al-Yahyaee (2008) for Oman. Frank and Jagannathan (1998) attribute the apparently abnormal returns to prices that bounce between the bid-ask spread.[17] Al-Yahyaee et al (2008) test this conjecture in Oman and find that the abnormal returns there disappear when midpoint prices rather than transaction prices are used (thereby supporting Frank and Jagannathan's hypothesis).

[17] The transactions before ex-day tend to occur at the bid (low) price and the sales on ex-day at the ask (high) price.

The possible presence of tax arbitrageurs and apparently anomalous behaviour at and near dividend ex days raises significant doubts about the use of dividend drop-off studies to infer conclusions about the value of dividends (and therefore imputation credits as well), and this point is well recognised in the corporate finance literature. For example, Grinblatt and Titman (2002, page 544) say that "Other evidence leads us to suspect that the observed behaviour of stock prices on ex-dividend dates may have nothing to do with taxes". In addition, after referring to studies that reveal positive abnormal ex-dividend day returns in markets without taxation of dividends, Welch (2009, page 723) states that "This evidence should caution us not to overinterpret the US cum-to-ex price drop as a pure marginal tax effect. We may not understand this drop as well as we think."

Australian researchers have reiterated the same concerns. For example, Brown and Clarke (1993) examine dividend drop-off ratios in Australia over periods following a number of changes in tax legislation that favoured dividends over capital gains, they find results that are sometimes inconsistent with tax-based explanations for the drop-off, and they conclude that "..the tax laws are not the whole of the explanation for the ex-dividend day trade-off between dividends and capital gains." (ibid, page 36). In addition, Walker and Partington (1999) estimate the value of dividends and U by another methodology, they find markedly higher values for dividends and imputation credits through this approach, they refer to microstructure and tax arbitrage complications in interpreting results from traditional drop-off studies, and they state that "This raises the issue of whether use of the traditional drop-off ratio may lead researchers to make erroneous inferences." (ibid, page 294). In addition, Cannavan, Finn and Gray (2004, section 3.3) also seek to estimate the value of Australian imputation credits by another methodology, they note the concerns about microstructure and tax arbitrage in interpreting results from traditional drop-off studies, and conclude that "For these reasons, it is unlikely that the traditional ex-dividend day drop-off methodology will be able to separately identify the value of cash dividends and imputation credits." Remarkably, the last author here (Professor Stephen Gray) is also the lead author on the SFG report. Even more remarkably, in an earlier version of the SFG (2013) paper, and in the course of noting disadvantages of the drop-off methodology, SFG (2008, para 90) state that "..the additional trading (around ex-dividend dates) may be driven by short-term investors seeking to capture the dividend and franking credit, affecting the resulting estimates." Thus even SFG have significant doubts about the ability of their own methodology to reliably estimate the tax effects that it seeks to.

In respect of tax arbitrage around dividend ex-days, the ENA (2013, section 7.9) argues that this would lead to *U* being overestimated by such studies (because these arbitrageurs would tend to drive up the prices of shares with large imputation credits prior to ex-day in the course of buying them, and then depress them shortly afterwards in the course of selling them). This point would be plausible if tax considerations fully explained ex-dividend day results. However, as described above, this is not the case.

Amongst these concerns, an issue common to many of them is the considerable variation in results, and this adversely affects the credibility of all such estimates. However, in respect of the dividend drop-off studies, SFG (2012, pp. 10-12) argues that, despite the variation in estimates of *U* from different studies, these studies agree on the value of the dividend plus the imputation credit and diverge only in respect of how that total is allocated between the cash dividend and the imputation credit; this implies that estimates of the two coefficients are negatively correlated For example, SFG claim that SFG (2011) values \$1 of imputation credit at 0.35 and \$1 of cash dividend at 0.85, and therefore a \$1 dividend coupled with the maximum imputation credit of \$0.43 would be worth

$$Total = \$1(0.85) + \$0.43(0.35) = \$1$$

Similarly, SFG claim that Beggs and Skeels (2006) values \$1 of imputation credit at 0.57 and \$1 of cash dividend at 0.80, and therefore a \$1 dividend coupled with the maximum imputation credit of \$0.43 would be worth

$$Total = \$1(0.8) + \$0.43(0.57) = \$1$$

However the second calculation produces \$1.05 rather than \$1. More importantly, SFG's observation is not relevant to the issue at hand. The purpose of these studies is to estimate *U* rather than the combined package of cash and imputation credit. Furthermore, even if SFG's implicit claim that the estimates of the two parameters (the value of cash and the value of credits) are negatively correlated were correct, leading to small variations in the value of the package, such negative correlation aggravates the variation in the estimates of *U* because *U* is the ratio of second parameter to the first. For example, for the first of the two studies described above (SFG, 2011), the implied estimate for *U* is 0.41 as follows:

$$U = \frac{0.35}{0.85} = 0.41$$

whilst the implied estimate of *U* from the second study (Beggs and Skeels, 2006) is 0.72 as follows

$$U = \frac{0.57}{0.80} = 0.72$$

So, because the estimate for the coefficient on cash dividends is negatively correlated with that on franking credits, the estimates for *U* vary even more than would otherwise be the case.

In conclusion, and in view of the concerns listed above, I concur with the AER's view that estimates of *U* derived from market prices warrant low weight.

3.6 An Alternative Interpretation of the Market Evidence

SFG (2012, section 7) notes that the AER previously partly relied upon Beggs and Skeels (2006, Table 5) to provide an estimate of *U*, that this estimate of *U* from Beggs and Skeels is associated with an estimate of the value of (unfranked) dividends relative to capital gains of 0.8, and that the latter is inconsistent with the use of the Officer CAPM (which assumes that unfranked cash dividends and capital gains are equally valued). SFG then argue for eliminating the inconsistency, and claim that two options are present:

(a) to consistently estimate the ratio of unfranked cash dividends to capital gains at 1, or

(b) to consistently estimate this ratio at 0.8.

They favour the first option, on the grounds that it allows continued use of the Officer CAPM. SFG also argue that empirical studies consistently find that the combined value of dividends with maximum imputation credits is $1 per $1 of cash dividends. Consequently, SFG claim that *U* must be zero.

Since the AER no longer places much weight on market-based estimates of *U*, this critique of the AER has lost most of its force. However, the same argument could be applied to anyone who uses both the Officer CAPM and market-based estimates of *U* and it also represents a different way of looking at the market-based evidence on *U*; it therefore warrants consideration. I disagree with SFG's argument for the following reasons. Firstly, SFG's argument here for *U* = 0 is inconsistent with the conclusions expressed in their dividend drop-off studies (SFG, 2011, 2013a), in which they favour *U* = .40. Secondly, SFG's argument is also internally inconsistent, in simultaneously asserting that imputation credits are worthless, that the combined value of dividends with maximum imputation credits is $1 per $1 of cash dividends, and that the value of unfranked dividends is $0.85 to $0.90 per $1 of dividends (SFG, 2012, pp. 10-12). If the combined value of dividends with maximum imputation credits is $1 per $1 of cash dividends, and the value of unfranked dividends is $0.85 to $0.90 per $1 of dividends, then the utilisation rate must be 0.30 rather than zero. Thirdly, choosing a parameter value simply because it is consistent with a model that is currently in use is a reversal of the usual (and sensible) direction of inference; a model should be (and usually) chosen because it best reflects the empirical evidence and the empirical evidence here is that the assumption of equal value for unfranked dividends and capital gains is wrong.

Fourthly, the claim that empirical studies consistently find that the combined value of cash dividends and imputation credits is $1 per $1 of cash dividends is not correct. In respect of Australia since the introduction of imputation, Beggs and Skeels (2006, Table 5) obtain results ranging from $0.93 (1989-1990) to $1.24 (1999-2000) whilst Brown and Clarke (1993, Table 7) estimate the coefficients on unfranked dividends and credits as 0.88 and 0.46 respectively, and therefore a combined value per $1 of cash dividends of $1.17. Fifthly, if it were true that the combined value of the dividends and credits is $1 in an imputation regime, and the credits had no value, then the unfranked dividends would be worth $1 and therefore we would expect to see dividends valued at $1 in non-imputation regimes. However, in such regimes, the weight of evidence from dividend drop-off studies is that dividends are valued less than capital gains. For example, Brown and Walter (1986, Table 2) find a mean value per $1 of dividend of $0.77 for Australia in the pre-imputation period 1974-1985, Bell and Jenkinson (2002, Table V) find $0.78 for the UK for the post-imputation period 1997-1999, and Graham et al (2003, Table II) find $0.81 for 1996-1997 and $0.78 for 1997-2000 in the US (which has never had imputation). Finally, even if it were true that the combined value of a $1 dividend and the maximum imputation credits were $1, one is not free to choose the value of one parameter on non-empirical grounds and then deduce the value of the other, i.e., multicollinearity cannot be waved away merely by choosing one of the parameter values to address an unrelated issue.

Having disagreed with SFG's view, my own is as follows. Dividend drop-off studies reveal that unfranked dividends are valued less than capital gains, and this is inconsistent with the Officer CAPM. However, as discussed in section 3.5, these drop-off studies are subject to so many methodological problems that they should not be given much weight. Nevertheless, the same result arises in the work of Cummings and Frino (2008), who examine simultaneous prices for a share index and futures contracts over it, and also in the work of SFG (2013b), who examine simultaneous prices for shares and futures contracts over shares. Collectively, this work supports rejection of the Officer CAPM in favour of a CAPM that recognises that unfranked dividends and capital gains are not taxed equally (such as Lally, 1992, Cliffe and Marsden, 1992, or Lally and van Zijl, 2003). However, until this point is reached, it would not be sensible to choose an estimate of U merely to paper over the empirical challenges to the Officer CAPM.

3.7 The Views of Practitioners

The AER (2013, section 8) refers to a number of surveys of practitioner behaviour. These include KPMG (2013, pp. 26-28), who surveyed a (small) number of practitioners and found that 53% - 94% explicitly adjusted for imputation credits depending upon the type of business being valued and that, where imputation credits were included in cash flows at a specified utilisation rate, this rate averaged 75%. In respect of earlier surveys referred to by the AER, KPMG (2005) surveyed expert reports prepared in response to takeover offers and found that none of the experts made an adjustment for imputation credits. In addition, Truong et al (2008) surveyed the CFOs of major Australian companies and found that, amongst the respondents who also responded to the specific question about imputation, 13 made adjustments and 64 did not (ibid, Table 9). All of this suggests that there is a trend amongst practitioners towards explicit adjustment for imputation credits.

The AER (2013, section 8) also notes that, amongst those practitioners who did not make any explicit allowance for the credits and provided reasons for doing so, in general, the reasons given were typically that the adjustment is uncertain and/or complex rather than a belief that $U = 0$. This supports a positive value for U.

The AER (2013, section 8) also refers to its earlier paper (AER, 2009, pp. 404-410), in which it argued that the absence of an adjustment for U in both the cash flows and the discount rate still leads to correct valuations. This is too strong a claim; the correct position is that, so long as $E(R_m)$ or the MRP exclusive of the credits is correctly estimated, an analyst who does not make any explicit allowance for the credits will still produce valuations that are correct on average over firms because $E(R_m)$ will have fallen after imputation was introduced, and explicit adjustment for the credits is required only to deal with firms that are not typical. Thus the crucial issue is not whether practitioners make an explicit allowance for U but what value for U is embedded in market prices. To demonstrate this point, I start with the Officer model for valuing the equity of a company as shown in equation (3):

$$S_0 = \frac{Y_1 - TAX_1 + IC_1 U + S_1}{1 + R_f + \phi\beta_e}$$

where S_0 is the current equity value of the company, S_1 the expected value in one year, Y_1 the expected cash flows over the first year (net of all deductions except company taxes), TAX_1 the expected company taxes over the first year, IC_1 the expected imputation credits distributed over the first year, and ϕ the market risk premium in the Officer CAPM. Substituting for the market risk premium using equations (1) and (2):

$$S_0 = \frac{Y_1 - TAX_1 + IC_1 U + S_1}{1 + R_f + [E(R_m) + U\frac{IC_m}{S_m} - R_f]\beta_e}$$

If the cash flows are expected to grow at a constant rate g, this reduces to

$$S_0 = \frac{Y_1 - TAX_1 + IC_1 U}{R_f + [E(R_m) + U\frac{IC_m}{S_m} - R_f]\beta_e - g} \qquad (7)$$

Thus, the utilisation rate U appears in the model in both the numerator and the denominator, and its impact depends upon the level of imputation credits at the firm level (numerator) and the market level (denominator). For a typical firm, characterised by a beta of 1 and an average imputation-to-value ratio:

$$\beta_e = 1, \quad \frac{IC_1}{S_0} = \frac{IC_m}{S_m}$$

these two effects offset, and equation (7) reduces to the following

$$S_0 = \frac{Y_1 - TAX_1}{R_f + [E(R_m) - R_f]\beta_e - g} \tag{8}$$

This is the valuation model that would be used by those who don't make any (explicit) allowance for imputation credits anywhere in the formula. However this model will correctly allow for the effect of the credits on the equity value of the average firm, so long as $E(R_m)$ or the MRP is correctly estimated. For firms with a lower than average beta and a higher than average imputation-to-value ratio, the allowance via a lower value for $E(R_m)$ will be insufficient; otherwise, it will be too high. Furthermore, if an analyst believes that $U = 0$, it is not sufficient to simply use equation (8) rather than (7); it would also be necessary to adjust their estimate of $E(R_m)$ or the MRP to strip out the market's view about U that is impounded in $E(R_m)$, and this would clearly be difficult.

Handley (2010, section 4) also asserts that the correct valuation result will arise even if imputation credits are not explicitly recognised but he (wrongly) believes that this is true in general rather than only for firms that match the market in respect of beta and the imputation-to-value ratio. Furthermore, amongst the respondents to the survey conducted by Truong et al (2008) who offered an explanation for not making explicit adjustment for the credits, 23% did so because they considered that the effect of the credits was already impounded into market prices and would therefore be reflected in the estimated cost of capital.

To illustrate all this, suppose that just before imputation the aggregate market equivalent to Y_1 is Y_m = \$10b, the aggregate market equivalent to TAX_1 is TAX_m = \$3b, $R_f = .05$, $E(R_m) = .11$, and $g = .052$. Using the market level equivalent of equation (6), the value of the market portfolio would be

$$S_m = \frac{\$10b - \$3b}{.05 + (.11 - .05) - .052} = \$120.7b$$

Now suppose imputation is introduced, 90% of all company taxes are distributed as imputation credits and $U = 1$. The value for $E(R_m)$ should fall (from 11%) by an amount exactly matching the personal tax benefits from imputation, and therefore the MRP in the Officer CAPM would be unchanged (at 6%). Using the market level equivalent of equation (7) again, the result would be as follows:

$$S_m = \frac{\$10b - \$3b + \$2.7b}{.05 + .06 - .052} = \$167.2b \tag{9}$$

It follows that IC_m/S_m = \$2.7b/\$167.2b = .0161 and therefore $E(R_m)$ = 11% - 1.61% = 9.39%. So, the value of the market portfolio S_m rises from \$120.7b to \$167.2b, and $E(R_m)$ falls from 11% to 9.39%, as a result of imputation. Consider now a specific firm, which matches the market portfolio apart from scale (being 0.1% of the market), i.e.,

$$Y_1 = \$10m, \quad TAX_1 = \$3m, \quad IC_1 = \$2.7m, \quad \beta_e = 1, \quad g = .052$$

Following equation (7), the pre-imputation value of that firm will be \$120.7m and the post-imputation value will be \$167.2m. Now consider an analyst who makes no (explicit) allowance for imputation credits and therefore uses equation (8) rather than equation (7). So long as they correctly estimate $E(R_m)$, as well as g, they will correctly estimate the equity value of the firm as follows:

$$S_0 = \frac{\$10m - \$3m}{.05 + (.0939 - .05)(1) - .052} = \$167.2m$$

This correct valuation of the equity arises because the firm is typical of the market in the relevant respects and all other parameters have been correctly estimated. However, if the firm is untypical, then equation (8) will err. For example, suppose that that only 50% of a firm's company taxes are distributed as imputation credits, i.e., IC_1 = \$1.5m. Following equation (7), the correct value of the firm will then be as follows:

$$S_0 = \frac{\$10m - \$3m + \$1.5m}{.05 + .06 - .052} = \$146.5m$$

By contrast, following equation (8), the firm would continue to be valued (wrongly now) at \$167.2m. So the firm will be overvalued because its imputation-to-value ratio is low.

To illustrate how $E(R_m)$ or the MRP could still be correctly estimated, suppose that a practitioner (who makes no explicit allowance for imputation credits) uses the DGM approach to estimating the MRP after the introduction of imputation. This would involve solving equation (9) for the MRP:[18]

$$\frac{\$10b - \$3b}{.05 + \phi - .052} = \$167.2b$$

The solution is an (imputation-exclusive) MRP estimate of 4.39%, which is the correct value after imputation has been introduced. In effect, the market value of $167.2b impounds the market-wide effect of imputation credits and any analyst can observe this market value.

On the other hand, an analyst who estimates the MRP (exclusive of imputation credits) by historical averaging of the Ibbotson type is likely to overestimate the current value for this parameter because most of the data used will predate the introduction of imputation. In the above example, this MRP was 6% pre-imputation and 4.39% afterwards. If most of the data is pre-imputation, the MRP estimate will tend to be closer to 6% than 4.39%. However, even in this case, the analyst will have (unintentionally) incorporated part of the imputation effect into their valuation.

In respect of other survey evidence SFG (2012, section 6) cites the Queensland Government Treasury (2006) in support of the claim that Queensland government entities ignore imputation credits in project evaluation. This situation has no relevance to regulation, because the 'owners' of these entities do not receive dividends and therefore the value of imputation credits is moot. SFG (2012, section 6) also claims that credit agencies ignore imputation credits in assessing the credit ratings for Australian companies. This is unsurprising given that imputation does not reduce company payments (despite the fact that the Officer CAPM treats imputation as reducing the effective company tax rate), and therefore has no bearing on the question of whether imputation credits are valuable to investors. Similarly, if the Australian government announced a scheme to pay shareholders $1 for each $1 received in dividends, the creditworthiness (and hence credit ratings) of companies would be unaffected whilst their market value would rise. The only clear effect that imputation would have on the

[18] Firms are assumed to pay all available cash flow as dividends.

creditworthiness of companies would be to reduce it in so far as it induced companies to raise their dividends, but credit ratings presumably account for dividends anyway.

In summary, it appears that there is a trend towards practitioners explicitly allowing for imputation credits, the latest evidence suggests a value for U of 0.75 amongst this group, and the rest generally appear to believe that U is positive. Furthermore, even without explicit allowance for imputation credits, practitioners will on average correctly value firms in a world in which U is positive so long as they correctly estimate the values of other parameters, and therefore the crucial issue is not whether practitioners explicitly allow for U but what value for U is embedded in market prices and whether analysts reflect this in their estimate of the MRP. All of this supports a positive value for U.

3.8 Other Approaches

The AER (2013, pp. 135-136) refers to the existence of managed funds that focus upon firms with high imputation credit payout rates, and observes that their existence implies that some investors value these credits. From this the AER concludes that U is positive. By contrast, the ENA (2013, section 7.7.4) notes that the demand for such funds (from investors who can use the credits) will be greater the lower is the extent to which market prices reflect the usefulness of the credits. However there is no inconsistency in these perspectives, because they spring from different definitions of U. If U is defined as the value-weighted average of individual investors' utilisation rates, as the AER (properly) do, the existence of the funds implies that U is positive (and possibly as great as 1). By contrast, if U is defined in market value terms as the ENA do, the existence of the funds implies that U must be less than 1 and possibly as low as zero.

The AER (2013, page 136) also refers to recently proposed changes in tax law to prevent investors from engaging in certain types of complex transactions designed to enable them to benefit from imputation credits. From this the AER again concludes that U is positive. By contrast, the ENA (2013, section 7.7.5) notes that such legislation would reduce the value of U. As in the previous paragraph, the difference in conclusions springs from the difference in the definitions of U. If U is defined as the value-weighted average over individual investors' utilisation rates, as the AER properly does, their interpretation of the event is correct.

Both of these points are minor. One does not need to observe either type of event to know that Australian resident investors can fully utilise imputation credits.

3.9 A Test for Reasonableness

The Officer (1994) CAPM implicitly assumes that national markets for risky assets are completely segmented, in the sense that investors are precluded from purchasing foreign risky assets. However, most estimates of U reflect the presence of foreign investors. Consequently the potential for economically unreasonable estimates of the cost of equity arises, i.e., values that lie outside range of those arising under complete segmentation and complete integration of national markets for risky assets. In this event the partial recognition of foreign investors would effectively constitute cherry-picking that maximises the revenue or price cap, i.e., ignoring foreign investors when it is favourable to regulated firms (choosing the CAPM) and also estimating U by a methodology that reflects the presence of these investors when it is also favourable to regulated firms. We therefore assess whether various estimates of U lead to this outcome.

To do so it is necessary to consider the implications for the cost of equity of complete integration and complete segmentation of national markets for risky assets. It will also be desirable to impound all of the effects of imputation within the cost of equity capital rather than partly within the cash flows; it will then be sufficient to examine only the cost of equity capital. I start with the model used by Australian regulators, which is the Officer (1994) model. This model specifies the cost of equity consistent with cash flows being defined to incorporate the firm-specific effects of imputation (i.e., dividends are defined to include, and company taxes are defined to exclude, imputation credits in so far as they can be used). This is denoted $\hat{k}_e$, and is as follows:

$$\hat{k}_e = R_f + \phi\beta_e \tag{10}$$

where R_f is the Australian risk free rate, ϕ is the Australian market risk premium defined to include imputation credits in so far as they can be used, and β_e is the beta of the company's equity against the Australian market. If the effects of imputation are instead fully incorporated into the cost of equity, the result (denoted k_e) is as follows:

$$k_e = R_f + \phi\beta_e - I_e U \tag{11}$$

where I_e is the expected ratio of imputation credits to equity value for the firm in question (see Appendix 2).

Turning now to complete segmentation of national markets for risky assets, the same model would be appropriate. However all investors in Australian stocks would be Australians and all of them can now use the imputation credits; so, U would be 1.[19] Furthermore, the numerical value for the MRP might differ from that adopted by regulators because the former reflects complete segmentation of equity markets whilst the latter might be affected by the presence of foreign investors in the Australian market. Letting ϕ_S denote the market risk premium within the Officer model for Australia under complete segmentation of national markets for risky assets, the cost of equity under complete segmentation and inclusive of the effects of imputation credits, denoted k_e^S, would then be as follows:

$$k_e^S = R_f + \phi_S \beta_e - I_e \qquad (12)$$

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). I will invoke this model because, dividend imputation aside, it closely parallels the Officer model. As with most international versions of the CAPM, international capital flows are assumed to be unrestricted and investors exhibit no irrational home country biases, i.e., there is no preference for local assets for non-financial reasons. Like the standard version of the CAPM, it assumes that interest, dividends and capital gains are equally taxed. The resulting cost of equity for an Australian company under complete integration, denoted k_e^I, would be as follows:

$$k_e^I = R_f + \phi_w \beta_{ew} \qquad (13)$$

[19] Consistent with this, Handley and Maheswaran (2007, Table 4) found that 100% of the imputation credits attached to dividends received by Australian resident investors were redeemed against their tax liabilities; their data covered the period since the tax changes in July 2000, which granted rebates to Australian investors who could not fully utilise the credits. In an earlier paper (Handley and Maheswaran, 2003), involving data from the period 1989-2000, they found that 90% of the credits were redeemed against tax liabilities.

where R_f is (as before) the Australian riskfree rate, ϕ_w is the risk premium on the world market portfolio, and β_{ew} is the beta of the company's equity against the world market portfolio. By contrast with the Officer CAPM, there is no recognition of dividend imputation (which is approximately correct because only a small proportion of investors can now benefit from imputation credits). The remaining, and significant, distinction between the two models lies in the definition of the market portfolio, i.e., the "market" is Australia in the Officer model and the world in the Solnik model. Thus the market risk premiums may differ across the two models and the beta of a firm's equity is defined against a different market portfolio.

I now seek to compare the regulatory approach in equation (11) to the extreme cases shown in equations (12) and (13). The Australian risk free rate R_f is common to all three models, and therefore the choice of a value is not significant.[20] So, I set the value at .03, corresponding to the yield to maturity on ten year government bonds in recent times.[21] In respect of the market risk premium and the equity beta within equation (10), I invoke values commonly used by Australian regulators, i.e., $\phi = .06$ and $\beta_e = 1$.[22] In respect of the ratio of imputation credits to equity value I_e, the relevant ratio in a regulatory context is that arising from the regulatory modelling process rather than the actual ratio. However, a useful starting point would be to consider the average actual ratio over Australian firms, and this is the product of the average cash dividend yield and the average ratio of imputation credits to cash dividends. In respect of the average ratio of imputation credits to cash dividends for Australian firms, the maximum ratio is 43% (arising from a corporate tax rate of 30%) and the average is about 75% of the maximum (see Brailsford et al, 2008, footnote 23), implying an average ratio of credits to dividends of 32%. In respect of the average cash dividend yield of Australian firms, this is currently about 0.05 (CEG, 2012, Figure 5). The product of these two numbers is 0.016.

In respect of the market risk premium in the Solnik model, in which markets are assumed to be completely integrated, investors will now be holding a world rather than a national portfolio of

[20] CAPMs treat the risk free rate as exogenously determined, and therefore the same empirically observed rate applies to both the Officer and Solnik models, i.e., the fact that foreign investors affect the Australian risk free rate is not inconsistent with the use of the Officer model. Furthermore, within the Solnik model, exchange rate risk is the same on both foreign risky and risk free assets and therefore cancels out in the market risk premium.

[21] Data from the website of the Reserve Bank of Australia (www.rba.gov.au).

[22] The same equity beta appears in equation (12), because the beta is defined against the Australian market portfolio in both cases and integration of markets does not affect this parameter. By contrast, integration will tend to affect the value for the market risk premium.

equities, and the latter will have a lower variance due to the diversification effect. Since the market risk premium is a reward for bearing risk, then the world market risk premium under complete integration should be less than that for Australia under complete segmentation. This market risk premium cannot be estimated in the usual way by averaging of the ex-post outcomes over a long period. This is because integration would reduce the market risk premium, and therefore the averaging process would have to be conducted only over the period since complete integration. Since complete integration has clearly not been attained, let alone for a long period, there is no relevant data. An alternative approach is suggested by Stulz (1995), who argues that, if the ratio of the market risk premium to variance is the same across countries under segmentation, the same ratio will hold at the world level under integration and this fact should be invoked in estimating the world market risk premium. Letting this ratio be denoted Q, the variance on the world market portfolio be denoted σ_w^2, and the variance on the Australian market portfolio be denoted σ^2, the market risk premium for the Solnik CAPM under complete integration relative to that of the Officer model under complete segmentation would then be as follows:

$$\frac{\phi_w}{\phi_S} = \frac{Q\sigma_w^2}{Q\sigma^2} = \frac{\sigma_w^2}{\sigma^2} \tag{14}$$

So, the ratio of the two market risk premiums is equal to the ratio of the two variances. Using data from Jan 1985 to July 2012, the variances for the Australian and world markets are estimated at $.164^2$ and $.147^2$ respectively.[23] Using these estimates in conjunction with equation (14), the implied value for ϕ_w is then as follows:

$$\phi_w = \frac{0.147^2}{0.164^2}\phi_S = 0.80\phi_S \tag{15}$$

The parameter ϕ_S reflects complete segmentation of equity markets. By contrast, the parameter ϕ appearing in equation (10) reflects present conditions, which involves some degree of market integration rather than complete segmentation. However, the degree of

[23] The Australian Index used is the ASX200 back to Jan 1993, and the ASX30 before that, whilst the world index is the MSCI.

integration is still rather limited.[24] Furthermore, the QCA's estimate of .06 for the parameter ϕ clearly places considerable weight on historical averaging of Australian market returns (QCA, 2011, pp. 238-240), and most of this data reflects complete segmentation. In recognition of partial integration, suppose that ϕ lies midway between ϕ_S and ϕ_w. Furthermore, in recognition of the QCA's estimate for ϕ placing substantial weight upon historical averaging, suppose that the QCA's estimate of .06 lies midway between ϕ_S and the true value for ϕ. It follows that the QCA's estimate of .06 lies 25% of the way from ϕ_S to ϕ_w. In conjunction with equation (15), this implies that

$$\frac{\phi_S - .06}{\phi_S - \phi_w} = \frac{\phi_S - .06}{\phi_S - 0.80\phi_S} = 0.25$$

It follows that $\phi_S = .063$ and $\phi_w = .051$.

The final parameter to estimate is the beta in Solnik's model. The average Australian stock has a beta against the Australian market portfolio of 1, by construction. Similarly, the average asset world-wide has a beta against the world market portfolio of 1, but this does not imply that the average Australian stock has a beta of 1 against the world market portfolio. Ragunathan et al (2001, Table 1) provides beta estimates for a variety of Australian portfolios for the period 1984-1992, against both Australian and world market indexes. The average of the latter to the former is about 0.40. Using data from Jan 1985 to July 2012, to match the period used to estimate the market variances, the beta for the Australian market against the world market is 0.75.[25] These results suggest that the betas of Australian firms against the world market portfolio are considerably less than against the Australian market portfolio. Given a generally employed value for β_e of 1, and the estimate of 0.75 described above, we therefore adopt an estimate for β_{ew} of 0.75.

[24] Coen (2001, Table 1) summarises the results for nine major markets, and reveals that the ratio of domestic to total worldwide equities held by investors exceeds the domestic market weight by a substantial margin in all nine markets (the averages are 82% and 11% respectively).

[25] The Australian Index used is the ASX200 back to Jan 1993, and the ASX30 before that, whilst the world index is the MSCI. The standard error on the estimate of 0.75 is 0.045, and therefore the estimate of 0.75 is both quite precise and statistically significantly different from 1.

In summary, my parameter estimates are I_e = 0.016, ϕ_w = .051, ϕ_S = 0.063, and β_{ew} = 0.75. In addition, in respect of the Officer model used by regulators, I consider regulatory estimates for U of 1, 0.625 (which the QCA uses), 0.35 (which the AER currently uses), and 0. The results from (12), (13) and (11) are then as follows.

Complete segmentation:	$k_e^S = .03 + .063(1) - .016 = .077$
Complete integration:	$k_e^I = .03 + .051(.75) = .068$
Officer with U = 1:	$k_e = .03 + .06(1) - .016(1) = .074$
Officer with U = 0.625:	$k_e = .03 + .06(1) - .016(.625) = .080$
Officer with U = 0.35:	$k_e = .03 + .06(1) - .016(.35) = .084$
Officer with U = 0:	$k_e = .03 + .06(1) - .016(0) = .090$

Unsurprisingly, the cost of equity under complete integration (6.8%) is less than under complete segmentation (7.7%), because the world MRP is less than the Australian MRP under complete segmentation and Australian stocks in general have lower betas against the world portfolio than against the local market portfolio. Furthermore, the estimated cost of equity using the Officer model in conjunction with an estimate for U of 0.625, of 8.0%, is higher than under complete segmentation, and therefore above the plausible band from 6.8% to 7.7%. The situation is even worse with lower estimates of U: an estimate for U of 0.35 yields an estimated cost of equity of 8.4% whilst an estimate for U of 0 yields an estimated cost of equity of 9.0%.

This perverse result occurs despite the fact that the MRP estimate for the Officer model that is generally used by regulators (6%) lies between the MRPs for the two extreme models (which is sensible). The source of the problem is an estimate for U that is not only less than 1 but sufficiently below it to more than neutralise the fact that the MRP estimate in the Officer model used by regulators lies between the two extreme cases. This might seem counterintuitive; as one goes from a world of complete segmentation to complete integration, U must go from 1 to 0, and the use of an intermediary estimate such as 0.625 would seem to be sensible for an intermediary scenario. However, as one moves from a world of complete segmentation to complete integration, the model used should also change and this is not done. Instead regulators are using a model that presumes complete segmentation and populating it with an estimate for U that reflects partial segmentation. The result is regulatory estimates of the cost of equity that lie outside the bounds of complete segmentation and complete integration. Given the use of the Officer model by regulators, and an MRP estimate that can reasonably be presumed to lie between the two extreme cases, the only values for U that produce sensible estimates for the cost of equity are those from 0.80 to 1, yielding costs of equity from 7.4% to 7.7%.

These results are contingent upon the estimate for the variance ratio shown in equation (15) and the application of market-wide parameter values for I_e and β_{ew} to all firms. Accordingly, I consider the consequences of a range of values for each of these parameters. In respect of the imputation ratio I_e, which is 0.016 for the market in aggregate, I consider a band of values from .008 to .024. In respect of β_{ew}, which I estimate at 0.75 for the Australian market in aggregate, I consider a range of values from 0.65 to 0.85.[26] Finally, in respect of the variance ratio shown in equation (15) and estimated at 0.80, I consider a range of values from 0.70 to 0.90, implying a range of values for ϕ_w from .045 to .055 (and associated values of ϕ_S from .065 to .062).

Table 3 below shows the results from equations (12), (13) and (11) in that order, for this range of values for I_e, ϕ_w, ϕ_S and β_{ew}, along with an estimated value for U of 0.625.[27] The table shows that, in only 15% of cases (4/27, as shown in bold), the cost of equity that is generated by the Officer model with a utilisation rate on imputation credits of 0.625 is *within* the range of values arising from either complete segmentation or complete integration of equity markets; otherwise, the cost of equity from the Officer model is above that range. These four exceptions occur for extreme parameter combinations in the table.

Table 3: The Cost of Equity Capital Under Three Models with Estimated U = .625

			β_{ew} = .65			β_{ew} = .75			β_{ew} = .85		
Model	ϕ_w	ϕ_S	I_e = .008	.016	.024	I_e = .008	.016	.024	I_e = .008	.016	.024
Seg	.045	.065	**.087**	.079	.071	**.087**	.079	.071	**.087**	.079	.071
Int	.045	.065	**.059**	.059	.059	**.064**	.064	.064	**.068**	.068	.068
Off	.045	.065	**.085**	.080	.075	**.085**	.080	.075	**.085**	.080	.075

[26] The Australian and world market portfolios may differ in volatility, due inter alia to different leverages. If so, this will be reflected in different estimates of their market risk premiums as shown in equation (14).

[27] The results for the preceding example are shown in the centre of the table.

Seg	.051	.063	.085	.077	.069	.085	.077	.069	.085	.077	.069
Int	.051	.063	.063	.063	.063	.068	.068	.068	.073	.073	.073
Off	.051	.063	.085	.080	.075	.085	.080	.075	.085	.080	.075
Seg	.055	.062	.084	.076	.068	.084	.076	.068	.084	.076	**.068**
Int	.055	.062	.066	.066	.066	.071	.071	.071	.077	.077	**.077**
Off	.055	.062	.085	.080	.075	.085	.080	.075	.085	.080	**.075**

If this estimate for *U* of 0.625 is lowered then the proportion of cases lying within the bounds arising from either complete segmentation or complete integration of equity markets would decline. With an estimate for *U* of 0.35, as currently used by the AER, the proportion of such cases would fall to zero, i.e., the cost of equity resulting from the model used by Australian regulators would always lie above the range arising from either complete segmentation or complete integration of equity markets. By contrast, if the estimate for *U* were raised, the proportion of such cases would rise. With an estimate of 1, the proportion of such cases would rise to 74%, i.e., the cost of capital estimated from the Officer model would lie within the required range in 74% of cases, as shown in bold in Table 4 below. The fact that, even with *U* = 1, there are still some cases in which the cost of capital from the Officer model lies outside the bounds described here reflects the use of a version of the CAPM that presumes that markets for risky assets are completely segmented coupled with an estimate of the market risk premium (6%) that at least partly reflects the impact of integration. In effect, using *U* = 1 eliminates the principal but not the only conflict between the assumptions underlying the Officer model and the parameter values that are generally employed by Australian regulators.[28]

Table 4: The Cost of Equity Capital Under Three Models with Estimated *U* = 1

			$\beta_{ew} = .65$			$\beta_{ew} = .75$			$\beta_{ew} = .85$		
Model	ϕ_w	ϕ_S	I_e = .008	.016	.024	I_e = .008	.016	.024	I_e = .008	.016	.024
Seg	.045	.065	**.087**	**.079**	**.071**	**.087**	**.079**	**.071**	**.087**	**.079**	.071
Int	.045	.065	**.059**	**.059**	**.059**	**.064**	**.064**	**.064**	**.068**	**.068**	.068
Off	.045	.065	**.082**	**.074**	**.066**	**.082**	**.074**	**.066**	**.082**	**.074**	.066

[28] If the Officer model in equation (11) used an estimate of the market risk premium that prevailed under market segmentation, equation (11) would coincide with equation (12) and all sources of conflict would then be eliminated.

Seg	.051	.063	**.085**	**.077**	**.069**	**.085**	**.077**	.069	**.085**	**.077**	.069
Int	.051	.063	**.063**	**.063**	**.063**	**.068**	**.068**	.068	**.073**	**.073**	.073
Off	.051	.063	**.082**	**.074**	**.066**	**.082**	**.074**	.066	**.082**	**.074**	.066
Seg	.055	.062	**.084**	**.076**	.068	**.084**	**.076**	.068	**.084**	.076	.068
Int	.055	.062	**.066**	**.066**	.066	**.071**	**.071**	.071	**.077**	.077	.077
Off	.055	.062	**.082**	**.074**	.066	**.082**	**.074**	.066	**.082**	.074	.066

In summary, in the face of an inconsistency between the use of the Officer model (which assumes that national equity markets are segmented) and an estimate of the utilisation rate on imputation credits that is less than 1 (which reflects the presence of foreign investors), a minimum requirement is that the results from this approach should lie within the bounds arising from complete segmentation of national equity markets and complete integration (to ensure that the cost of capital results are consistent with some scenario regarding segmentation or integration). However, estimates of *U* that are significantly less than 1 fail this test in virtually every case examined, and are therefore deficient. In effect, combining Officer's CAPM with a utilisation rate that is significantly less than 1 constitutes a defacto form of cherry-picking of parameter values and models that maximises the price or revenue cap for regulated businesses. By contrast, if the Officer model were combined with a utilisation rate on imputation credits of 1, or close to it, the test described here would be satisfied in most cases. All of this suggests that, if the Officer model is used, the only sensible estimate of the utilisation rate is at or close to 1.

In response to this argument, SFG (2012, para 100) argues that estimates of parameters must be consistent in the sense that, if any of them are premised on the absence of foreign investors (as in the case of $U = 1$), then all of them should be subject to the same requirement, including the risk free rate. Equally, if the risk free rate that is used in the model is the observed risk free rate, and this recognises the impact of foreign investors, the same approach should be taken to estimating *U*. The same argument is raised by the ENA (2013, section 7.4.5). This argument presumes that a proper use of the Officer CAPM would require use of a risk free rate that prevailed under complete segmentation of markets. However this is not correct. The Officer CAPM, like all CAPMs, treats the risk free rate as exogenous to the model (Sharpe, 1964; page 433; Mossin, 1966, page 774). Accordingly, it is appropriate to use the observed risk free rate regardless of how it is determined, whether by government decree, the actions of a central bank, or by foreign investors. The problems arise only for the MRP and *U*. A strict application of the model would require that these two parameter values exclude the impact of foreign investors. A less strict application of the model would involve parameter values that reflected the presence of foreigners, but subject to the requirement that the resulting estimate of the cost of equity be economically reasonable, and this points to an estimate for *U* of close to 1.

3.10 Summary

The AER draws upon estimates of *U* based upon the "equity ownership" approach, the "redemption rate" approach, the use of market prices, and practitioner surveys. In respect of the first two methods, the AER considers that they each point to an estimate of about 70%. In respect of estimates derived from market prices, the AER considers that this approach gives rise to such a wide range of results, and suffers from so many methodological issues, that such estimates are not very useful. Finally, in respect of surveys of practitioners, the AER considers that the results are inconclusive but suggest that in general practitioners believe that *U* is positive even if they are not sufficiently confident about it to adopt an explicit estimate. Having considered all this evidence, the AER has estimated *U* at 0.70.

I concur with the AER on their conclusions in respect of these four methods, subject only to observing that the best available estimate for the "redemption rate" is 0.40 to 0.80 rather than 0.70. However I think that the AER should also have given consideration to defining *U* to exclude foreign investors, consistent with the Officer CAPM. Accordingly the only holders of Australian equities would be Australian residents. Since *U* is a value-weighted average over the utilisation rates of individual investors and all Australian residents (including individuals, superannuation funds, and tax-exempt entities) are able to fully utilise these credits, by offset against other tax obligations or by a tax refund, and therefore have utilisation rates of 1, then *U* would be 1.

Inclusive of this approach, there are five possible approaches to estimating the utilisation rate. The first of these arises from the definition of the parameter as a weighted average across all investors; coupled with ignoring foreigners (consistent with the Officer CAPM), this yields an estimate of 1 (the utilisation rate of local investors). The second possibility also arises from the definition of the parameter, but with recognition of foreigners, and leads to an estimate of about 0.70 (the proportion of Australian equities held by Australians). The third possibility is to use the proportion of credits that are redeemed with the Australian tax authority by all investors, and leads to an estimate of about 0.40 to 0.80, with a midpoint of 0.60. The fourth possibility is to use market prices, from cum and ex-dividend share prices, simultaneous share and futures prices, simultaneous share index and futures prices, and regressions of returns on imputation credit yields. Using results from post July 2000, and using the parameter estimates favoured by the authors where there is variation, the results are 0.40 (SFG, 2013a), 0.13 (SFG, 2013b), 0.64 (Cummings and Frino, 2008), and -2.00 (NERA, 2013b). If the last result is ignored, on the grounds of complete implausibility, the average is 0.39. The fifth possibility is to draw upon surveys of market practitioners, which reveals a trend towards explicit recognition of the credits, with the latest evidence suggesting a value for U of 0.75 amongst those who make explicit adjustments and the rest generally appear to believe that U is positive despite not making explicit adjustments. So, it does not produce a point estimate.

In my view, the most important requirements in selecting a methodology for estimating U are that the estimate be consistent with the definition of U, as a value-weighted average over the utilisation rates of all investors who are relevant to the Officer CAPM, that the parameter estimate is likely to give rise to an estimated cost of equity from the Officer model that lies within the bounds arising from either complete segmentation or complete integration of equity markets, and that the estimate is reasonably precise. The first approach described in the previous paragraph satisfies each of these requirements and is therefore recommended. The second approach described in the previous paragraph satisfies the third of these requirements, but not the first because it recognises foreign investors and not the second in the sense that its associated estimate of U would give rise to implausibly high costs of equity; it is therefore ranked second. The third approach (the proportion of credits redeemed with the tax authorities) is similar to the second but lacks its precision and therefore does not satisfy any of these requirements. The fourth approach (using market prices) does not satisfy any of these requirements, because it is not a value-weighted average over all investors, its estimate of U would give rise to implausibly high costs of equity, and the estimate is very imprecise in the sense that the approach generates a wide range of estimates depending upon the specific methodology and data used, the estimates from the dividend drop-off studies may also reflect broader anomalies unrelated to tax issues, it is exposed to the actions of a small and unrepresentative set of investors, and it is exposed to microstructure effects such as the bid-ask bounce. It also produces ancillary results relating to the valuation of cash dividends that are inconsistent with the Officer model. The fifth approach does not produce a point estimate. Using the three criteria described above, my preferred estimate is 1 from the first approach and my second preference is 0.70 from the second approach. If these three criteria were rejected, I would favour use of the results from the first four approaches, with values of 1, 0.70, 0.60, and 0.39; the problems associated with the third and fourth methods warrant a lower weighting than on the other methods and therefore an estimate for U of about 0.80.

4. Estimating the Distribution Rate

4.1 The AER's Approach

The AER (2013, section 8.3.4) favours an estimate for the distribution rate of 70%, based upon analysis by NERA (2013a, Table 2.2), which in turn is based upon an examination of ATO data since the introduction of imputation. NERA consider two possible approaches to estimating the distributed credits. The first approach (the "tax approach") involves tax paid net of the change in the franking account, whilst the second approach (the "dividend approach") involves the level of franked dividends paid multiplied by the maximum attachment rate. The second approach is considered less reliable and produces a lower result. The AER concurs with NERA's choice.

Estimates from other researchers, drawing upon ATO data and also using the "tax approach", yield very similar results. In particular, Hathaway (2010, page v) yields an estimate of 69%, and Hathaway (2013, page 7) slightly raises this to 71%. In addition, NERA estimates it as 69% since inception and 70% in the last five years (NERA, 2013a, Table 2.2). The consistency in these estimates encourages confidence in them. However, some alternative points of view warrant consideration, as discussed in the next section.

4.2 Alternative Empirical Approaches

The estimates discussed in the previous section are all estimates of the market-level distribution rate. By contrast, within the Officer (1994) model and as shown in equation (3), the distribution rate is a firm specific parameter rather than a market average parameter. However firm-specific estimates of the distribution rate are subject to the difficulty that, if the firm's dividends are fully franked, then the firm will be able to manipulate (raise) its price or revenue cap by reducing its dividends (so as to reduce its distributed credits, which lowers its distribution rate and therefore raises its cost of capital estimated from the Officer model used by regulators).

An alternative would then be some kind of industry average, and the relevant industry is regulated businesses. However many of them are publicly owned and do not pay dividends.

The alternative would then be to examine a set of large private-sector Australian firms that contain significant regulated businesses. However the set of firms is not large and therefore the choice of whether or not to include certain marginal cases is likely to materially affect the resulting estimate. These difficulties are absent or minimal from the market-wide data, because all firms are included. However there is considerable variation in the rate across firms (as will be discussed soon) and therefore the market-wide average could be a poor indicator of the situation for any industry. This issue could be framed as a trade-off between statistical reliability (greater from a market-wide estimate) versus potential bias (worse from a market-wide estimate), and the AER (2013, section 8.3.3) favours the market-wide distribution rate because it improves the statistical reliability of the estimate.[29] The same point arises in estimating the asset beta and the leverage of the benchmark firm. Since regulators use industry rather than market averages in these cases, consistency might suggest the same decision in respect of the distribution rate. However the proper choice depends upon the severity of the bias and statistical reliability problems in each of these areas, and different decisions might be warranted.

A further complication is in the choice of data used to estimate the market-level distribution rate. The ATO data suggests a figure of 70% but NERA (2013a) identifies some difficulties in the underlying data. An alternative approach would be to estimate the distribution rates for the largest Australian companies, using data from their Annual Reports. I therefore focus upon the ten largest Australian listed companies, which comprise 50% of the ASX200 market capitalisation.[30] All but three of them have current franking balances (recorded in the "dividend" note to the financial statements) that are either zero (implying a distribution rate of 1) or sufficiently small relative to company tax payments to imply a distribution rate close to 1. Of the three exceptions (BHP, Woolworths, and Woodside), Woodside has the highest ratio of current franking balance to tax paid ($3391m/$604m = 5.6) and is therefore likely to have the lowest distribution rate. I therefore examine it more closely. The current franking balance (at 31.12.2012) of $3391m is the result of company tax payments since 1987 less credits distributed. The company tax payments from 2001-2012 inclusive are $6300m, with data

[29] Bias will arise if industry or market-level data are used because the parameter value varies over firms. Industry-level data is likely to be less biased because firms within the same industry are likely to be less variable than firms in general.

[30] These companies are CBA, BHP Billiton, Westpac, ANZ, NBA, Telstra, Woolworths, Wesfarmers, CSL and Woodside Petroleum.

drawn from the "Statement of Cash Flows" in the annual report for each year. The annual reports for earlier years are not posted to the company's website but the growth rate in company taxes paid over the period 2001-2012 (from \$433m to \$604m) is 2.8% p.a. Applying the same growth rate to earlier tax payments yields taxes paid of about \$4800m over the period 1987-2000 inclusive. Thus, since imputation was introduced, the company has paid taxes of about \$11,100m and a franking balance of \$3391 remains. Consequently, 30% of the taxes paid have not been distributed as imputation credits and therefore the distribution rate is 70%.[31] Thus, with seven companies having distribution rates at or close to 1, and the other three having rates of at least 70%, the market average distribution rate would appear to be over 90%. This implies that the ATO-based market-average distribution rate of 70% is very conservative.

All of the estimates discussed above are also based upon historical data. However the exercise in question involves valuation and therefore the relevant distribution rate is that expected in the future, for which historical experience is merely a guide. Handley (2009, section 2) argues that the progressive build up in undistributed credits will eventually attract the attention of corporate raiders etc, that history has shown that financial markets are innovative when the incentives are large, and therefore favours a distribution rate of 1. However Handley simply assumes that distribution of the credits (via higher dividends) would be desirable, because the Officer model implies that they are, i.e., within the Officer model, the only effect of a firm distributing additional imputation credits would be to lower the effective company tax payments and therefore raise the value of the firm as shown in equation (3). However this result only holds because, within the Officer model, gross dividends are assumed to be taxed at the same rate as capital gains, and this is not true in Australia. If one recognises that capital gains are taxed at a lower rate than gross dividends in Australia, it may not be optimal to pay the higher dividends; for example, Lally (2011) shows in such a case that the valuation effect of paying higher dividends in order to release undistributed imputation credits may be neutral. The most that can be said here is that there is some probability that undistributed credits will at some future time be distributed (as argued by McKenzie and Partington, 2010, page 8). Thus, the use of historical data that yields a distribution rate less than 100% is likely to underestimate the future

[31] It is possible that some of the company taxes paid were paid to foreign tax authorities rather than to the ATO and therefore the distribution rate would be lower. However the fact that the company has such a large franking balance implies otherwise. Furthermore, the company taxes paid to the ATO (and therefore eligible for distribution as credits) in each year is equal to the increase over the year in the franking balance plus the credits distributed, and the latter is the dividends paid multiplied by (.30/(1-.70)) for fully franked dividends. Performing such a calculation for some years yields results close to the company taxes paid, and therefore confirms that most or all of the company taxes paid were paid to the ATO.

rate. However there is no reasonable basis for estimating this probability. Furthermore, results from Hathaway (2010, page v), Hathaway (2013, page 7), and NERA (2013a, Table 2.2) reveal that the quantity of undistributed credits (at the market-wide level) has been growing progressively over a long period rather than as having arisen only recently. Since there is no reasonable basis for estimating what proportion of these undistributed credits will ever be distributed, and it seems unlikely that most of them will ever be, I recommend that the historical data be used to estimate the distribution rate.

4.3 Theoretical Approaches

More theoretical arguments, for a distribution rate of 1, have also been raised. In particular, the AER (2009, page 410) argued for such a rate on the basis that full distribution of free cash flows is the standard assumption for valuation purposes. I do not agree with this approach, for the following reasons. Firstly, the claim is not true; the standard assumption is merely that there is no retention of free cash flow after allowance for interest, repayments of principal and new investment. Thus, if an (all equity) firm generates free cash flows of \$10m and has new investment of \$4m, the standard assumption is that dividends less new share issues must be \$6m. So, if new share issues are \$3m, dividends must be \$9m. Alternatively, if new share issues are zero, then dividends must be \$6m.

Secondly, even if there were no new share issues or new investment, in which case all of the free cash flows of an (all equity) firm would be assumed to be paid as dividends, this does not imply that the distribution rate for imputation credits would be 1. To illustrate this point, suppose that a firm has free cash flow of \$10m, taxable income of \$16m (and therefore company tax payments of \$4.8m), and no new investment or new share issues. All of the free cash flow of \$10m is then distributed as dividends but the maximum imputation credits that could be attached (to dividends of \$10m) would be \$4.3m. Accordingly the distribution rate for the imputation credits would be 90% as follows:

$$D = \frac{IC}{TAX} = \frac{\$4.3m}{\$4.8m} = .90$$

The fact that the distribution ratio is less than 1 arises from the fact that the free cash flow before company tax (\$14.8m) is less than the taxable income (\$16m), and there is nothing anomalous about this. Free cash flow before deduction of company tax embodies a deduction for the cost of asset replacements whilst taxable income instead embodies a deduction of tax depreciation and the latter are generally smaller than the former (even over the life of the asset in question) because tax depreciation reflects the historic purchase price of the assets and replacement costs are larger due to inflation.

Thirdly, even if the standard valuation assumption did imply that all free cash flow were distributed as dividends, and this in turn implied a distribution rate of 1, regulators are not compelled to act as if all the standard valuation assumptions are valid. The guiding principle in regulation is to choose parameter values to satisfy the NPV = 0 principle, i.e., the present value of the future cash flows should match the initial investment. One of these future cash flows is tax, and the relevant tax figure is that which is paid rather than what would be paid if certain assumptions generally employed in valuation were in fact true.

Handley (2009, section 2) also argues that the payout rate should be treated as 1, because the Officer framework assumes that cash flows are (level) perpetuities. This is true but the Officer framework to which Handley refers involves more than the Officer CAPM (which makes no such assumption) and Australian regulatory bodies in general have adopted only the Officer CAPM rather than the entire Officer framework.

4.4 Summary

In summary, the various theory-based arguments (all for a distribution rate of 1) are not justified, and therefore an empirical estimate is warranted. Within the Officer model, the distribution rate is firm specific. However, the use of firm-specific estimates is ruled out by the resulting incentives of firms to manipulate their dividend levels. The choice then lies between an industry average and a market average. Industry averages are likely to be an ongoing source of contention, involving which firms to choose and how much historical data to use. These difficulties are absent from a market average but there is considerable variation in the rate across firms and therefore the market-wide average could be a poor indicator of the situation for any industry. So, the appropriate choice is not clear but I favour the market-wide average. Finally, since the relevant distribution rate is the expected future rate and historical data reveals that a significant proportion of credits have not been distributed, it might be argued that they eventually will be and therefore the expected future distribution rate must exceed the historical rate. However, there is no strong theoretical argument for eventual distribution and therefore historical experience must be favoured as an estimator for the future. Invoking the historical market-wide data, from both the ATO and from annual reports, this points to an estimate for the distribution rate of at least 70%.

5. Conclusions

My principal conclusions are as follows. In respect of the imputation utilisation rate, there are five possible approaches to estimating the utilisation rate. The first of these arises from the definition of the parameter as a weighted average across all investors; coupled with ignoring foreigners (consistent with the Officer CAPM), this yields an estimate of 1 (the utilisation rate of local investors). The second possibility also arises from the definition of the parameter, but with recognition of foreigners, and leads to an estimate of about 0.70 (the proportion of Australian equities held by Australians). The third possibility is to use the proportion of credits that are redeemed with the Australian tax authority by all investors, and leads to an estimate of about 0.40 to 0.80, with a midpoint of 0.60. The fourth possibility is to use market prices, from cum and ex-dividend share prices, simultaneous share and futures prices, simultaneous share index and futures prices, and regressions of returns on imputation credit yields. Using results from post July 2000, and using the parameter estimates favoured by the authors where there is variation, the results are 0.40, 0.13, 0.64, and -2.00. If the last result is ignored, on the grounds of complete implausibility, the average is 0.39. The fifth possibility is to draw upon surveys of market practitioners, which reveals a trend towards explicit recognition of the credits, with the latest evidence suggesting a value for U of 0.75 amongst those who make explicit adjustments and the rest generally appear to believe that U is positive despite not making explicit adjustments. So, it does not produce a point estimate.

In my view, the most important requirements in selecting a methodology for estimating U are that the estimate be consistent with the definition of U, as a value-weighted average over the utilisation rates of all investors who are relevant to the Officer CAPM, that the parameter estimate is likely to give rise to an estimated cost of equity from the Officer model that lies within the bounds arising from either complete segmentation or complete integration of equity markets, and that the estimate is reasonably precise. The first approach described in the previous paragraph satisfies each of these requirements and is therefore recommended. The second approach described in the previous paragraph satisfies the third of these requirements, but not the first because it recognises foreign investors and not the second in the sense that its associated estimate of U would give rise to implausibly high costs of equity; it is therefore ranked second. The third approach (the proportion of credits redeemed with the tax authorities) is similar to the second but lacks its precision and therefore does not satisfy any of these requirements. The fourth approach (using market prices) does not satisfy any of these requirements, because it is not a value-weighted average over all investors, its estimate of *U* would give rise to implausibly high costs of equity, and the estimate is very imprecise in the sense that the approach generates a wide range of estimates depending upon the specific methodology and data used, the estimates from the dividend drop-off studies may also reflect broader anomalies unrelated to tax issues, it is exposed to the actions of a small and unrepresentative set of investors, and it is exposed to microstructure effects such as the bid-ask bounce. It also produces ancillary results relating to the valuation of cash dividends that are inconsistent with the Officer model. The fifth approach does not produce a point estimate. Using the three criteria described above, my preferred estimate is 1 from the first approach and my second preference is 0.70 from the second approach. If these three criteria were rejected, I would favour use of the results from the first four approaches, with values of 1, 0.70, 0.60, and 0.39; the problems associated with the third and fourth methods warrant a lower weighting than on the other methods and therefore an estimate for *U* of about 0.80.

In respect of the distribution rate, the various theory-based arguments (all for a distribution rate of 1) are not justified, and therefore an empirical estimate is warranted. Within the Officer model, the distribution rate is firm specific. However, the use of firm-specific estimates is ruled out by the resulting incentives of firms to manipulate their dividend levels. The choice then lies between an industry average and a market average. Industry averages are likely to be an ongoing source of contention, involving which firms to choose and how much historical data to use. These difficulties are absent from a market average but there is considerable variation in the rate across firms and therefore the market-wide average could be a poor indicator of the situation for any industry. So, the appropriate choice is not clear but I favour the market-wide average. Finally, since the relevant distribution rate is the expected future rate and historical data reveals that a significant proportion of credits have not been distributed, it might be argued that they eventually will be and therefore the expected future distribution rate must exceed the historical rate. However, there is no strong theoretical argument for eventual distribution and therefore historical experience must be favoured as an estimator for the future. Invoking the historical market-wide data, from both the ATO and from annual reports, this points to an estimate for the distribution rate of at least 70%.

Having offered estimates for *U* and the distribution rate, the estimate of gamma is the product of these. My preferred estimate for *U* is 1 from the first approach described above and, coupled with my estimate for the distribution rate of at least 0.70, yields an estimate for gamma of at least 0.70. My second preference in estimating *U* is 0.70 from the second approach described above and, coupled with my estimate for the distribution rate of at least 0.70, yields an estimate for gamma of at least 0.50. My third preference in estimating *U* is about 0.80, as described above, and, coupled with my estimate for the distribution rate of at least 0.70, yields an estimate for gamma of at least 0.56.

APPENDIX 1: Terms of Reference

Context

The AER is currently developing, in consultation with stakeholders, a guideline on how it will set the WACC in forthcoming determinations. This guideline also includes a method for estimating the value of imputation credits, which is an input into the cost of company tax formula. The guideline development is mandated by a recent rule change by the Australian Energy Market Commission (AEMC).[32] The guidelines will be non-binding, although the AER would be required to justify any departures from them.

In its draft guideline, the AER set out:

- a conceptual framework for estimating the value of imputation credits in the building block framework
- analysis of the available sources of evidence, with regard to this conceptual framework
- an estimate of the value of imputation credits, arising from this body of evidence.

Background documents for the advice

The primary background documents are the AER's draft guideline and the explanatory statement accompanying the draft guideline:

- AER, *Better regulation: Draft rate of return guideline*, 30 August 2013 (particularly pages 24–25)[33]
- AER, *Better regulation: Explanatory statement, Draft rate of return guideline*, 30 August 2013 (particularly pages 116–136 then appendix K on pages 232–247).[34]

The next most important background documents are the ENA submission in response to the draft guideline, and one of the three consultant reports on gamma accompanying this report:

32 Documents from the AEMC's rule change process can be found at: http://aemc.gov.au/Electricity/Rule-changes/Completed/economic-regulation-of-network-service-providers-.html

33 Available at: http://www.aer.gov.au/sites/default/files/AER%20Draft%20rate%20of%20return%20guideline%20-%20August%202013.pdf

34 Available at: http://www.aer.gov.au/sites/default/files/AER%20Explanatory%20statement%20-%20draft%20rate%20of%20return%20guideline%20-%20August%202013_0.pdf

- ENA, *Response to the draft rate of return guideline of the Australian Energy Regulator*, 11 October 2013 (particularly pages 48–55, then appendix B on pages 90–140)[35]
- NERA, *Imputation credits and equity prices and returns, A report for the Energy Networks Association*, October 2013 (particularly pages 3–10).[36]

All four of these documents are available on the AER website (and are linked below in footnotes).

The expert advice should also take into account the other key documents, which are listed in attachment 1 (together with web links). It is expected that the expert will engage more broadly, including relevant academic literature or other research.

Services Required

The consultant is to provide a critical review of the AER's draft guideline on gamma.

General critical review

Your advice should refer to the relevant sections of these documents, as well as any other relevant material. In the context of the AER's guidelines development, advice is sought on the following matters set out in grey boxes:

1. ***General critical review***. Provide a critical review of the AER's approach to setting the value of imputation credits in the draft guideline, as set out in the explanatory statement. In your review, please provide a critical review of the reasonableness of the AER's draft guideline position on:
    a. The conceptual framework
    b. The sources of evidence, including the analysis of their strengths and weaknesses
    c. The approach to drawing on the body of evidence, as opposed to seeking definitive single sources of evidence.

Within this general request for critical review, the AER has a number of more specific questions. It may be that the expert considers that these more specific questions can be best addressed in context when discussing all the strengths and weaknesses of the AER's approach in the draft guideline, as per the general question set out above. Alternatively, the specific questions below could be separately addressed after the main body of the report where you present your critical review. This is left to the expert's discretion; all that matters is that the answer to each question can be identified in the report.

The definition of gamma under the Officer framework

The AER states on page 119 of the explanatory statement:[37]

[35] Available at: http://www.aer.gov.au/sites/default/files/ENA%2C%20submission%20to%20draft%20AER%20rate%20of%20return%20guideline%20-%2011%20Oct%202013.pdf

[36] Available at: http://www.aer.gov.au/sites/default/files/ENA%2C%20Attachment%204%20-%20NERA%20Report%20-%20Imputation%20Credits%20and%20Equity%20Prices%2C%20Submission%20to%20draft%20AER%20rate%20of%20return%20guideline%20-%2011%20Oct%202013.pdf

[37] AER, *Explanatory statement, Draft rate of return guidelines*, 30 August 2013, page 118 (in the context of pp. 119–124, and 232–234).

> We propose that the value of imputation credits within the building block revenue framework is an estimate of the expected proportion of company tax which is returned to the representative investor through utilisation of imputation credits.

The AER sets out how it has arrived at this definition of gamma, and also how it considers this is consistent with the Officer (1994) framework:[38]

> This rule, and the Officer framework, suggests that the value of imputation credits is an estimate of the expected proportion of company tax which is returned to the representative investor through utilisation of imputation credits".

The ENA considers that the AER's definition of the value of imputation credits is incorrect, and states on page 97 of its submission in response:[39]

> Within the economic framework originally set out by Officer (1994), gamma represents (and has always represented) the market value of imputation credits (rather than a cash flow tracking analysis of the average utilisation of the credits).
>
> The AER should not substitute an average cash flow tracking interpretation for the accepted valuation interpretation of gamma.

Rather, the ENA considers that:[40]

> The role of gamma is to determine the return that comes from the value of imputation credits and consequently the reduction in the return to be paid out of allowed revenues.
>
> Gamma should not be interpreted in any other way, including as the expected proportion of corporate tax to be redeemed by the representative investor.

As to the implementation of this definition, the ENA emphasises the importance of 'market values' and states:[41]

> The relevant consideration when establishing a figure for gamma is a comparison of:
>
> a. The return on equity that the market would require from the benchmark firm *without* imputation; against
>
> b. The return on equity that the market would require from the benchmark firm *with* imputation.

2. ***Officer framework and gamma***. Is the AER's definition of the value for imputation credits (i.e. gamma) consistent with the Officer (1994) framework? Provide your reasoning.

    a. Is the ENA's definition of gamma consistent with the Officer (1994) framework? Provide your reasoning.

NOTE: This point is addressed in section 3.1 of the paper.

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38 AER, *Explanatory statement, Draft rate of return guidelines*, 30 August 2013, page 124.

39 ENA, *Response to the Draft rate of return guideline*, October 2013, p. 97 (in the context of pp. 49–50, 90–99).

40 ENA, *Response to the Draft rate of return guideline*, October 2013, p. 98.

41 ENA, *Response to the Draft rate of return guideline*, October 2013, p. 51; see also NERA, *Imputation credits and equity prices and returns*, October 2013, pp. 3–7.

The representative investor framework

The AER's interpretation of gamma set out above relies upon the definition of the representative investor, as set out in the explanatory statement:[42]

- The representative investor is a weighted average of investors in the defined market. Specifically, investors are weighted by their value weight (equity ownership) and their risk aversion. This means that the commonly referred to concept of the market price being set by the 'marginal investor' is not particularly meaningful or helpful in this context. Rather, the market price is set collectively by all investors, to the extent they participate in the defined market:
  - Consistent with the 2009 WACC review, we propose to define the market as an Australian domestic market that recognises the presence of foreign investors to the extent they invest in the Australian market. This definition reflects the realities of capital markets, and sits in between the purely theoretical definitions of a 'full segregated' market and a 'fully integrated' market. This definition has critical implications for the value of imputation credits.

However, the ENA considers that this 'representative investor' basis is inappropriate:[43]

> The ENA submits that (a) if the standard requirements for market clearing are not met, no equilibrium can be derived, no representative investor can be determined, and the CAPM pricing relation cannot be obtained, and (b) the standard market clearing conditions are not met in the "representative investor" framework set out in the explanatory statement.
>
> Consequently, using the aggregate redemption rate as an estimate of theta cannot be justified on the basis of a representative investor equilibrium.

Further, based on an expert report prepared by NERA, the ENA submits that the AER approach is flawed because it does not consider the effect of potential foreign investors who might otherwise invest in Australian firms in the absence of imputation:[44]

> Moreover, one cannot determine the impact of imputation credits distributed on the cost of equity from an analysis of domestic equity ownership prevalent under an imputation system. This is because equity ownership in the absence of an imputation system is likely to differ and ownership in the absence of an imputation system will play a role in determining the impact of credits on the cost of equity.

3. ***Representative investor framework***. Is the AER's consideration of the representative investor a reasonable basis to derive the value for imputation credits? Provide your reasoning.

   a. In view of your answer to (3), and noting the NERA submissions on the implications of foreign ownership, what are the strengths and weaknesses of the AER 'equity ownership' approach (pages 129–131 of the explanatory statement)?

   b. Are papers such as Lally and Van Zijl (2003), that use a representative investor framework to model the effect of imputation credits, all derived on the basis of a market clearing condition that requires that no investor in the particular market has access to any asset outside that market? For example, such a market clearing condition appears near the middle of p. 194 of Lally and van Zijl (2003). If an investor had access to assets outside "the market," would the

42 AER, *Explanatory statement, Draft rate of return guidelines*, 30 August 2013, pp. 119–120.

43 ENA, *Response to the Draft rate of return guideline*, October 2013, p. 107.

44 ENA, *Response to the Draft rate of return guideline*, October 2013, pp. 108–109 (in the context of pp. 101–108); see also NERA, Imputation credits and equity prices and returns, October 2013, pp. 7–10.

equilibrium outcome depend (among other things) on the risk and return of those investments and their correlation with the assets that are inside the market? That is, in reality, would investment opportunities outside a particular market be in any way relevant to the price an investor would be prepared to pay for an asset inside the market?[45]

Note: These points are addressed in sections 3.1 – 3.3 of the paper.

Trading around ex-dividend dates

In the explanatory statement, the AER noted the importance of observing conditions for the representative investor throughout the year:[46]

> We conclude that the representative investor … is the representative investor at any hypothetical point during a trading year—that is, it does not disproportionately reflect an investor or set of investors at a particular point in time. This is because investors may invest at any point during the year. If a benchmark parameter is set using data from a short period in systematically different trading circumstances to the rest of the year, it produces an estimate that is only relevant to those circumstances.

This was considered to be an issue for market based studies (such as dividend drop off studies):[47]

> There is substantial evidence suggesting that trading around the ex-dividend and cum-dividend days is not representative of the rest of the year. This is a significant problem, because all dividend drop-off data comes from trading on the cum-dividend day and ex-dividend day. This is different to all other market-based equity evidence (such as used for equity beta, MRP) which draws on trading throughout the year.

The ENA does not accept that market based estimates generated from this sort of limited period would be less relevant to the estimation of gamma. The ENA consider that there would be no material change in the composition of traders around the ex-dividend date:[48]

> The ENA submits that, the notion that a subset of "low valuation" investors dominate trading around the ex-dividend date causing the drop-off to be artificially low is directly contradicted by all of the available evidence and should be given no weight.

Further, to the extent that there was abnormal trading around the dividend date, the ENA considered that this would only be likely to result in an over-estimate of theta:[49]

> According to McKenzie and Partington, abnormal buying pressure causes an increase in the cum-dividend price and abnormal selling pressure causes a decrease in the ex-dividend price. To the extent that these effects are material, the result is a dividend drop-off that is larger than it would otherwise be. This results in the estimate of theta being larger than it would otherwise be. That is, to the extent that

45 Prior to issuing this TOR, the AER consulted with the Energy Networks Association, who requested that this specific question (3b) be included.

46 AER, *Explanatory statement, Draft rate of return guidelines*, 30 August 2013, pp. 128–129.

47 AER, *Explanatory statement, Draft rate of return guidelines*, 30 August 2013, p. 133.

48 ENA, *Response to the Draft rate of return guideline*, October 2013, p. 122 (in the context of pp. 119–123).

49 ENA, *Response to the Draft rate of return guideline*, October 2013, p. 121 (in the context of pp. 119–123).

the increase in trading volume around the ex-dividend date has an effect, it is likely to result in an over-estimate of theta.

4. ***Trading around ex-dividend dates***. To what extent is using market data from a limited window (i.e. the period around the cum-dividend and ex-dividend dates) a problem for market based studies? Provide your reasoning.

    a. Are abnormal trading conditions (to the extent that you consider they might exist) around the ex-dividend date likely to result in either an under-estimate or over-estimate of theta? Provide your reasoning.

Note: This point is addressed in section 3.5 of the paper.

APPENDIX 2: The Officer CAPM

This Appendix modifies the Officer (1994) model to incorporate the effective reduction in company taxes within the cost of equity capital.

Consider an unlevered business.[50] Let S_0 denote the current value of equity, S_1 the expected value in one year, Y_1 the expected cash flows over the first year to equity holders (net of all deductions except company taxes), TAX_1 the expected company taxes over the first year, d the proportion of these company taxes that are converted into imputation credits, and IC_1 the imputation credits over the first year. The present value of Y_1, S_1, and TAX_1 (net of that part distributed as imputation credits and utilised by investors), discounted using the Officer CAPM, is equal to S_0:

$$S_0 = \frac{Y_1 - TAX_1 + U(TAX_1)d + S_1}{1 + R_f + \phi\beta_e}$$

$$= \frac{Y_1 - TAX_1 + U(IC_1) + S_1}{1 + R_f + \phi\beta_e}$$

In this conventional formulation shown here, the benefits of imputation credits are reflected in the numerator, and this equation implies that

$$S_0(1 + R_f + \phi\beta_e) = Y_1 - TAX_1 + U(IC_1) + S_1$$

[50] The assumption of no leverage is adopted merely to simplify the presentation, and does not affect the result.

and therefore that

$$S_0\left[1+R_f+\phi\beta_e-U\frac{IC_1}{S_0}\right]=Y_1-TAX_1+S_1$$

and therefore that

$$S_0=\frac{Y_1-TAX_1+S_1}{1+R_f+\phi\beta_e-U\dfrac{IC_1}{S_0}}$$

In this equation, the benefits of imputation credits are now transferred to the cost of equity and this formulation of the cost of equity corresponds to equation (11).

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