# ESTIMATING GAMMA

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25 November 2013

The helpful comments of John Fallon and Michael Blake of the QCA are gratefully acknowledged. However all opinions expressed are those of the author.

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**EXECUTIVE SUMMARY**

This paper has sought to address a number of issues raised by the QCA relevant to the estimation of gamma, including the merits of a recent estimate by SFG. The conclusions are as follows.

In respect of the imputation utilisation rate (*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 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, because of the tax regime change at that point allowing rebates for unused credits 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 considered to be 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 the estimate is reasonably precise. The first approach described in the previous paragraph satisfies all of these requirements and is therefore recommended. The second approach described in the previous paragraph satisfies the first and third of these requirements, but not the second in the sense that its associated estimate of *U* would give rise to implausibly high costs of equity, and is therefore ranked second. The third approach (the proportion of credits redeemed with the tax authorities) satisfies only the first of these requirements, and is therefore ranked third. The fourth approach (using market prices) satisfies none 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 methodology generates a wide range of estimates depending upon the specific methodology and data used. For example, in SFG's dividend drop-off study, the deletion of less than 1% of the outliers selected using one particular methodology almost doubles the estimated value of *U*. The estimates from the dividend drop-off studies may also reflect broader anomalies unrelated to tax issues, the actions of a small and unrepresentative set of investors, and are exposed to microstructure effects such as the bid-ask bounce. The fourth approach 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 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 much 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. Such data is available from the ATO but there are concerns about it. Accordingly I favour an estimate using data from the financial statements of the ten largest ASX companies, and data for the period 2000-2013 is used. 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. Using the aggregate distribution rate of the ten largest ASX companies over the period 2000-2013, the estimated market-level distribution rate is 85%.

Finally, in respect of SFG's most recent arguments concerning the utilisation rate, I disagree with these arguments. Their most significant argument is that there is an inconsistency in the AER believing that the value of (unfranked) dividends relative to capital gains is about 0.80 and also using the Officer CAPM (which assumes that unfranked dividends and capital gains are equally valued), and this inconsistency should be eliminated by treating the ratio of unfranked dividends to capital gains at 1, on the grounds that it allows continued use of the Officer CAPM, and therefore *U* must be treated as zero because empirical studies consistently find that the combined value of dividends with maximum imputation credits is $1 per $1 of cash dividends. I agree that there is an apparent inconsistency between the unfranked dividend-to-capital gain ratio and the Officer CAPM. However SFG's beliefs are 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. Furthermore, one should not choose a parameter value (the unfranked dividend-to-capital gain ratio) simply because it is consistent with a model that is currently in use, nor is it true that empirical studies consistently find that the combined value of cash and imputation credits is $1 per $1 of cash dividends.

The empirical evidence on the dividend-to-capital gain ratio, from both dividend drop-off studies and other empirical work, points to the desirability of an alternative CAPM to that of Officer, so as to recognise the differential taxation of ordinary income and capital gains. 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.

## 1. Introduction

In October 2010, the ACT (2010, para 145) determined that the AER had erred in estimating the value of gamma, and it subsequently directed the AER to use a value of 0.25 constituting the product of a distribution rate of 0.7 and a utilisation rate of 0.35 (AER, 2011, para 42). Subsequently, several other Australian regulators adopted the same gamma value (ERA, 2011, page 141; IPART, 2011, section 8). However, more recently, concerns have been raised about this gamma estimate. In particular, the ERA (2013) favours a higher value of the utilisation rate using the same methodology favoured by the ACT, and the AER (2013, section 8) favours an estimate based upon a different methodology. Accordingly the QCA has asked me to undertake the following tasks:

- As background, to explain the mechanics of dividend imputation, its role in the Officer version of the CAPM that is used by Australian regulators, and whether undistributed credits have any value; and
- Estimate the utilisation rate using a variety of methods, and advise on the weights to be applied to these methods; and
- Estimate the distribution rate using a variety of methods, and advise on the weights to be applied to these methods; and
- Review SFG's (2012) report on gamma and, in particular, assess their claim that it is inconsistent of the AER to set the value of cash dividends to 100% when estimating the required return on equity but to use an estimate of 80% when estimating gamma.

## 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 imputation credits attached to a dividend 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.[1] 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.

[1] All Australian residents can fully benefits from the credits, and these benefits include tax rebates for those whose marginal tax rate is less than the company tax rate.

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. 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.

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% |

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) is 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. The proportion used (50%) is called the "utilisation rate".

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 event, 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, $\beta_e$ 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 $\phi$:

$$\begin{aligned} S_0 &= \frac{Y_1 - TAX_1 + IC_1U + S_1}{1 + R_f + \phi\beta_e} \\ &= \frac{Y_1 - TAX_1 + U(TAX_1)d + S_1}{1 + R_f + \phi\beta_e} \\ &= \frac{Y_1 - TAX_1(1 - Ud) + S_1}{1 + R_f + \phi\beta_e} \end{aligned} \tag{3}$$

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 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.[2] 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

[2] The intuition for the relevance of an investor's level of investment in risky assets is clear: those with higher such investment levels exert a greater impact on market prices, and therefore on the value of $U$.

‘profits’.[3] 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

$$IC \leq \min\left[TAX\,,\, DIV\left(\frac{T_c}{1-T_c}\right)\right] \leq \min\left[\$1m,\, \$1.29m\right] = \$1m \qquad (4)$$

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 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.

### *2.3 The Value of Undistributed Credits*

Imputation credits that are never distributed have no value. These are manifested in the distribution ratio *IC*/*TAX* being less than 1, thereby raising the effective company tax rate $T_e$ discussed in the previous two sections, and therefore raising the revenues or output price allowed by a regulator in compensation. If this distribution ratio is estimated from past behaviour, this implies that credits that have not yet been distributed never will be. Since this issue is inseparable from that of the best estimate of the distribution rate, I defer discussion of it to section 4.2.

[3] 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.

## 3. Estimating the Utilisation Rate

*3.1 Definition-Based Estimate*

The first possible approach to estimating *U* arises from the fact that the Officer CAPM assumes that national equity markets are completely segmented, i.e., investors are unable to purchase foreign equities. Accordingly the only holders of Australian equities would be Australian residents. Furthermore, *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, involving the receipt of tax refunds by those on low marginal tax rates, and therefore have utilisation rates of 1. So, *U* would be 1.

It is important to emphasise that this conclusion about the value of *U* arises from its definition, and this definition involves the ability or otherwise of various groups of investors to fully utilise the credits. The definition makes no reference to the market value of the credits.

*3.2 The Equity Ownership Approach*

The second possible approach to estimating *U* arises from the definition of *U* as a value-weighted average over the utilisation rates of individual investors, but without imposing the restriction that investors must be Australian residents. Consequently *U* would be a value-weighted average over the utilisation rates of locals and foreigners. Since foreigners cannot benefit from the credits (except through tax arbitrage), then *U* would be the proportion of Australian shares held by Australians. In respect of listed equity, this is currently about 60% (Black and Kirkwood, 2010, page 2). If unlisted equity were included, with valuations based upon accounting values, the result is (unsurprisingly) higher at about 70% (Australian Bureau of Statistics, 2007).

The drawback with this approach is that the estimate is inconsistent with the use of a CAPM that assumes complete segmentation of risky asset markets. 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. Every CAPM starts instead with a set of assumptions about investor behaviour and institutional features rather than a "market", 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 conflict between the recognition of foreigners within an empirical estimate of a parameter and the underlying assumptions of the model, such an approach to estimating $U$ has the perverse consequence that as national equity markets become increasingly integrated, foreign ownership of Australian equities will rise, the resulting estimate of $U$ will fall, and therefore the cost of equity capital estimated using the Officer model will rise. However, as markets become more integrated, investors will be holding more well diversified portfolios and therefore the cost of equity capital should fall. The problem arises from

[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.

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 3.7.

*3.3 The Use of Tax Department Data*

The third possible approach to estimating $U$ is to estimate the proportion of credits that are redeemed with the Australian tax authority by all investors. Handley and Maheswaren (2008, Table 4) estimate this proportion at 67% for 1988-2000 and 81% for 2000-2004. Since a significant tax change occurred in July 2000, allowing resident investors to fully benefit from credits, the latter estimate of 81% is preferred. More recently, using data from 2004-2011, Hathaway (2013, section 1.3) estimates this proportion at 62% or 44%, with the variation arising from two possible approaches whose data cannot be reconciled. In view of the latter problem, the earlier estimate of 81% from Handley and Maheswaren would seem to be preferable. However, Hathaway (2010, page v) emphasises 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 44% to 81%.

Estimates of this type reflect the presence of foreigners and therefore will be inconsistent with the use of a CAPM that assumes complete segmentation of risky asset markets. This leads to underestimating $U$. In addition, even if recognition of foreigners were warranted, tax arbitrage by foreigners would give rise to an estimate of the utilisation rate from this approach that was inconsistent with its definition as a weighted average over investors. For example, if foreigners avoid holding shares around ex-dividend days (notwithstanding legislative rules designed to discourage this) by temporarily transferring ownership to local investors, the estimate of the utilisation rate using this approach would over-weight the impact of domestic investors in the definition of the utilisation rate, and therefore overestimate the utilisation rate. However the legislative rules that discourage such behaviour are extensive and are likely to significantly curtail such activity, in which case the upward bias should not be great.[5] Consistent with this, the estimate of 81% from Handley

[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 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).

and Maheswaren (2008) and the higher estimate of 62% from Hathaway (2013) are not dramatically different to the estimate of 70% obtained in section 3.2.

*3.4 The Use of Market Prices*

The fourth possible approach to estimating *U* is to use market prices. Many of the authors who adopt this approach define *U* as the *value* (i.e., market value) of a distributed credit (for example, SFG, 2013a, para 8). The ERA (2013, page 5) goes even further and 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. Accordingly, the use of market prices to estimate *U* would seem not only natural but optimal. However, as discussed in section 3.1, *U* is a weighted average of the utilisation rates of investors rather than the market value (per unit) of the distributed credits, and therefore the most that can be said about this approach to estimation is that it *might* provide a good estimate. The same point is made by McKenzie and Partington (2010, pp. 7-8).

For example, suppose all investors can fully use the credits (in which case *U* must be 1), all sources of investment income are taxed at the same rate, there are no transactions costs, and investors are risk neutral. In such a world the expected share price drop on ex-day would be equal to the sum of the dividend and the imputation credits. So, providing that imputation credits are not too strongly correlated with the cash dividend (to obviate multi-collinearity problems) and the sample size is sufficiently large, the estimate of *U* obtained in a dividend drop-off study would be likely to be close to 1. However these idealised conditions are not met in the real world and therefore an estimate of *U* obtained from a dividend drop-off study may be an inappropriate estimate of the value-weighted average of individual investors' utilisation rates. For example, if capital gains and dividends are differently taxed, the share price drop-off will reflect the differential tax rate on these two types of income as well as *U*, requiring two parameters to be estimated and therefore increasing the risk of an inappropriate estimate of *U*. To take an extreme case, suppose that all investors can fully utilise the imputation credits but gross dividends are taxed at 100%. An examination of market prices would then reveal that gross dividends were worthless and therefore that the market value of imputation credits would be zero. However, it would still be true that *U* was 1.

Turning now to specific studies, I start with those that present results based upon data from after July 2000 (when the tax regime was changed, increasing the benefits from imputation credits). SFG (2013a) conduct a dividend-drop off study (method 1), over the period from July 2001 to October 2012, and this represents an update of SFG (2011). SFG conduct a series of OLS regressions (models 1…4), using about 3000 observations. They place the greatest reliance on their model 4, which involves regressing the share price change around ex-day on the dividend and the franking credits (the natural potential explanatory variables for the share price change), subject also to dividing through by the cum-dividend share price and the estimated volatility of the stock (so as to improve the statistical reliability of the model by seeking to eliminate any relationship between the variance of the regression residuals and the independent variables):

$$\frac{P_{it-1} - P_{it}^*}{P_{it-1}\sigma_i} = \delta \frac{D_i}{P_{it-1}\sigma_i} + \theta \frac{FC_i}{P_{it-1}\sigma_i} + \varepsilon_i \tag{5}$$

where $D_i$ is the cash dividend for the *i*th observation, $P_{it-1}$ is the cum-dividend stock price for the *i*th observation, $P_{it}^*$ is the ex-dividend stock price for the *i*th observation adjusted for the rate of return on the market index from the cum-dividend to the ex-dividend stock price, $FC_i$ is the franking credits for the *i*th observation, and $\sigma_i$ is the estimated standard deviation of stock *i* returns. The numerator on the left-hand side of the regression model is therefore an estimate of the price movement that is induced by the dividend. SFG interpret the coefficient $\delta$ as the market value per $1 of unfranked dividends and $\theta$ as the utilisation rate ($U$).

SFG also apply a modified regression process ("robust regression") to each of the four models, which automatically reduces the weight on extreme observations. The result is a series of estimates for $\delta$ and $\theta$, shown in their Tables 2 and 3 with estimates of $\delta$ ranging from 0.81 to 0.93 and estimates of $\theta$ ranging from 0.14 to 0.38. SFG conclude with an estimate of 0.85-0.90 for $\delta$ and 0.35 for $\theta$ (ibid, para 85), and they equate the latter with $U$. However, as discussed in Lally (2012, section 2.2), $\theta = \delta U$ and therefore SFG's estimate of 0.35 for $\theta$ implies an estimate for $U$ of 0.35/0.875 = 0.40.[6]

[6] This is essentially equivalent to saying that $U$ is the utilisation rate whilst $\theta$ is the market value per unit of credits. The same point is recognised by Handley (2008, page 11).

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. These estimates are shown in the last column of Table 2.[10]

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 | | |

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 0.55/0.86 = 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 Beggs and Skeels (2006, Table 5) also estimate *U* (at 0.57/0.80 = 0.72) over the period from July 2000 to 2004, but the methodology is similar to that of SFG (2013a) whilst the period examined is a subset of SFG's. Accordingly, I do not also include this result in Table 2. Also, Vo et al (2013) conduct a similar study to that of SFG (2013a). The contribution from this study is to test the sensitivity of SFG's results to various methodology changes, and will be discussed shortly.

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, I examine some studies using data within the period August 1991 to May 1997, and May 1997 to July 1999.[11] 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).[12] Also, in both the first and second periods, and using a dividend drop-off methodology (Method 1), Beggs and Skeels (2006, Table 5) estimate *U* at 0.23 for the first period and 0.53 for the second period.[13] All of these results are shown in Table 2.

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.

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[11] 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.

[12] 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*.

[13] 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.

Much of this cross-sectional and inter-temporal variation in results is likely to be a reflection of the statistical uncertainty that pervades all econometric work, and this arises from '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).[14] 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.[15] 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.

In addition to the wide variation in results, these market-based estimates are subject to a number of other limitations, as discussed in Lally (2012) and McKenzie and Partington (2010), as follows. Firstly, although *U* is a value-weighted average over all investors in the market at a point in time, the use of market prices from different points in time will produce an estimate of *U* that reflects the tax position and transactions costs of tax arbitrageurs and these investors may be only a small proportion 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. Consistent with this, Cannavan et al (2004, page 190) find that the estimate for *U* ranges from zero up to 0.40 depending upon the dividend yield and size of the firm, and they attribute this variation across firms to costly tax arbitrage by foreigners (who transfer the credits to local investors) in the firms that are larger and have higher dividend yields.

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

[15] 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.

Secondly, many dividend drop-off studies have identified various anomalies that cannot be attributed to any kind of tax explanation and the results may be at least partly caused by these broader anomalies. Both this point and the impact of tax arbitrageurs are generally recognised amongst finance researchers to cast doubts upon the ability of dividend drop-off studies to reliably estimate tax parameters, and these sceptics include SFG.

Thirdly, all of these studies are subject to the question of whether to include a constant in their regression model, the case for doing so is not clear cut and omission of the constant could materially alter the estimate for the utilisation rate. Fourthly, 'bid-ask bounce' can induce bias in results from dividend drop-off studies if the cum dividend prices tend to be at one end of this spread and ex-dividend prices at the other end.

Fifthly, all such studies must adopt rules for selecting observations, the choice is both subjective and it may materially alter the result. For example, in relation to 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.

Sixthly, 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 respect of SFG's preferred approach involving model 4 and "robust regression", SFG estimate *U* at 0.38 (SFG, 2013a, Table 3) whilst Vo et al (2013, Table 5) estimate it at 0.36. However, using OLS, SFG's estimate is 0.33 (SFG, 2013a, Table 2) whilst Vo et al (2013, Table 5) estimate it at -0.08. 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 (Vo et al, 2013, Table 8 and Figure 15). The associated coefficients on cash dividends are not given but it could be presumed that the estimate for *U* would also have almost doubled. 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 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).[16]

Seventhly, 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).[17] Again, the associated coefficients on cash dividends are not given but it could be presumed that the estimate for *U* would also have approximately doubled.

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

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 (2013a)

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

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

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, 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.[18]

Finally, the 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.

In summary, studies based on market prices are subject to a number of concerns. Firstly, as shown in Table 2, materially different results arise from different studies and these variations may be due to the usual statistical uncertainty that surrounds all econometric work. Secondly, as also shown in Table 2, there is no consistent pattern over time in these results. Thirdly, in respect of dividend drop-off studies, materially different results arise from the choice of methodology, the value for the tuning coefficient in robust regression, the extent to which outliers are deleted, and the procedure for deleting the outliers. Most dramatically, the deletion of less than 1% of the outliers using one particular methodology and varying the tuning coefficient in the robust regressions each double the estimated value of *U*. Fourthly, even when using the same methodology and almost identical data, materially different results have arisen from the Vo et al and SFG dividend drop-off studies at some points. Fifthly, some or all such results may be driven by the circumstances of a small and unrepresentative subset of investors, the filter rules for selecting data, bias arising from 'bid-ask bounce', the presence or absence of a constant, and broader anomalies unrelated to tax issues. Sixthly, all of these studies suggest that cash 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. Finally, the estimates from these studies are likely to reflect the presence of foreigners and therefore

[18] For example, consider equation (5) above, arising in SFG (2013a). SFG (2013a, Table 2 and Table 3) estimate the coefficient on unfranked dividends ($\delta$) at about 0.90 and this suggests that such dividends are taxed at about ten percentage points more than capital gains.

would be inconsistent with the use of a CAPM that assumes complete segmentation of risky asset markets. Even leaving aside the last two points, which raise questions of consistency with the Officer CAPM, these points collectively suggest that the use of market prices will not produce reliable estimates of *U*.

*3.5 The Views of Practitioners*

Surveys of practitioners reveal that there has been a trend in the last decade towards explicit adjustments for imputation credits. For example, KPMG (2005) surveyed expert reports prepared in response to takeover offers and found that none of the experts made an adjustment for imputation credits. Subsequently 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). More recently, KPMG (2013, pp. 26-28) surveyed a range of practitioners, including investment banks and professional services firms, and found that 53% explicitly adjusted for imputation credits in valuing businesses other than infrastructure, rising to 94% for infrastructure investments. Furthermore, where imputation credits were included in cash flows at a specified utilisation rate, this rate averaged 75%.

Amongst those practitioners who did not make any explicit allowance for the credits, this might be interpreted as a belief amongst this group that $U = 0$, and SFG (2012, page 1) hold this view. However, it is important to understand the reasons for the behaviour of practitioners. In respect of the KPMG (2005) study, 15 of the expert reports provide a reason for not making any adjustment for the credits. Of these, one expert did so because the assets of the company in question were located in a foreign country (and therefore no imputation credits would be available to Australian investors) whilst the remaining 14 did so because of uncertainty over the appropriate adjustment, and these 14 reports come from only two firms (Grant Samuel and Deloitte Corporate Finance) who could be presumed to impose a uniform view on this matter upon their individual valuers. Furthermore, in summarising the results, KPMG (2005, page 14) state that experts consider that "imputation credits are valuable to investors" despite the experts not explicitly adjusting for them. In respect of Truong et al (2008), amongst the firms who did not make adjustments and offered a reason for this, only 10% asserted that the value of credits was zero (ibid, page 116). Thus, even amongst practitioners who do not make any explicit adjustment for the credits, the general view would seem to be that $U$ is not zero, and therefore must be positive.

In addition, amongst the group who do not make explicit adjustments for the credits, so long as $E(R_m)$ exclusive of the credits is correctly estimated, an appropriate adjustment for imputation credits will arise 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. 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 to equity holders (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 $\phi$ 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

$$S_0 = \frac{Y_1 - TAX_1 + IC_1 U}{R_f + [E(R_m) + U\frac{IC_m}{S_m} - R_f]\beta_e - g} \qquad (6)$$

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 (6) reduces to the following

$$S_0 = \frac{Y_1 - TAX_1}{R_f + [E(R_m) - R_f]\beta_e - g} \tag{7}$$

This is the valuation model that would be used by those who don't make any (explicit) allowance for imputation credits. This model will correctly allow for the effect of the credits on the equity value of the average firm, so long as $E(R_m)$ is correctly estimated. However, ceteris paribus, for firms with a lower than average beta, the allowance via a lower value for $E(R_m)$ will be insufficient; otherwise, it will be too high. Similarly, ceteris paribus, for firms with 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 (7) rather than (6); it would also be necessary to adjust their estimate of $E(R_m)$ 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 (6) again, the result would be as follows:

$$S_m = \frac{\$10b - \$3b + \$2.7b}{.05 + .06 - .052} = \$167.2b \tag{8}$$

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 (6), 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 (7) rather than equation (6). 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 (7) 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 (6), 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 (7), 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 $E(R_m)$ 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 (8) for the MRP:[19]

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

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 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 what practitioners do but what value for *U* is embedded in market prices. All of this supports a positive value for *U* but a point estimate cannot be offered.

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

*3.6 Other Approaches*

The AER (2013, page 136) refers to the existence of managed funds that focus upon firms with high imputation credit payout rates, and (reasonably) observes that their existence implies that some investors value these credits. This suggests that *U* is positive but nothing more.

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. Again this suggests that *U* is positive but nothing more.

*3.7 Overall Test*

I now turn to an overall test of reasonableness of these competing estimates of *U*. This test springs from the fact that the Officer (1994) CAPM implicitly assumes that national markets for risky assets are completely segmented, i.e., investors are precluded from purchasing foreign risky assets.[20] Consequently the use of an estimate for *U* that is potentially significantly influenced by the presence of foreign investors is inconsistent with this model. A pragmatic response to this might be to argue that the shortcoming from use of a model that implicitly (and wrongly) ignores foreign investors should not be compounded by using an estimate of *U* that also fails to reflect the same phenomenon. However, the resulting cost of equity should lie between the results that would arise if foreign investors were completely ignored and if they were fully recognised, i.e., it should generate a result that lies within the range of those arising under complete segmentation and complete integration of national markets for risky assets. Otherwise, the 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* satisfy this test.

To do so it is necessary to consider the implications for the cost of equity under both complete integration and complete segmentation of national markets for risky assets. It will also be desirable to impound the effects of imputation within the cost of equity capital rather

[20] The same implicit segmentation assumption underlies the standard CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966). See footnote 4.

than within the cash flows; it will then be sufficient to examine only the cost of equity capital for the purpose of comparison. 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:

$$\hat{k}_e = R_f + \phi\beta_e \tag{9}$$

where $R_f$ is the Australian risk free rate, $\phi$ is the Australian market risk premium defined to include imputation credits in so far as they can be used, and $\beta_e$ 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:

$$k_e = R_f + \phi\beta_e - I_e U \tag{10}$$

where $I_e$ is the expected ratio of imputation credits to equity value for the firm in question (see Appendix, with $I_e$ abbreviating here for $IC_1/S_0$).

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.[21] 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 $\phi_S$ 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:

[21] Consistent with this, Handley and Maheswaren (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 Maheswaren, 2003), involving data from the period 1989-2000, they found that 90% of the credits were redeemed against tax liabilities.

$$k_e^S = R_f + \phi_S \beta_e - I_e \tag{11}$$

Turning now to complete integration of national markets for risky assets, versions of the CAPM have been developed that recognize that international investment opportunities are open to investors, starting with Solnik (1974). We will invoke this model because, dividend imputation aside, it closely parallels the Officer model. 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:[22]

$$k_e^I = R_f + \phi_w \beta_{ew} \tag{12}$$

where $R_f$ is (as before) the Australian risk-free rate, $\phi_w$ is the risk premium on the world market portfolio, and $\beta_{ew}$ 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 (10) to the extreme cases shown in equations (11) and (12). The Australian risk free rate $R_f$ is common to all three models, and therefore the choice of a value is not significant.[23] So, I set the value at .03, corresponding to

[22] Intuitively the risk free rate in the model is the Australian rate because if risk evaporates on an Australian asset, it is then equivalent to the Australian risk free asset and must then have the same rate of return.

[23] 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.

the yield to maturity on ten year government bonds in recent times.[24] 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.[25] 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 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 $\sigma_w^2$, and the variance on the Australian market portfolio be denoted $\sigma^2$, the market

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

[25] The same equity beta appears in equation (11), 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.

risk premium for the Solnik CAPM under complete integration relative to that of the Officer model under complete segmentation would then be as follows:

$$\frac{\phi_w}{\phi_S} = \frac{Q\sigma_w^2}{Q\sigma^2} = \frac{\sigma_w^2}{\sigma^2} \tag{13}$$

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.[26] Using these estimates in conjunction with equation (13), the implied value for $\phi_w$ is then as follows:

$$\phi_w = \frac{0.147^2}{0.164^2}\phi_S = 0.80\phi_S \tag{14}$$

The parameter $\phi_S$ reflects complete segmentation of equity markets. By contrast, the parameter $\phi$ appearing in equation (10) reflects present conditions, which involves some degree of market integration rather than complete segmentation. However, the degree of integration is still rather limited.[27] Furthermore, the QCA's estimate of .06 for the parameter $\phi$ 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 $\phi$ lies midway between $\phi_S$ and $\phi_w$. Furthermore, in recognition of the QCA's estimate for $\phi$ placing substantial weight upon historical averaging, suppose that the QCA's estimate of .06 lies midway between $\phi_S$ and the true value for $\phi$. It follows that the QCA's estimate of .06 lies 25% of the way from $\phi_S$ to $\phi_w$. In conjunction with equation (14), this implies that

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

[27] 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).

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

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.[28] 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 $\beta_e$ of 1, and the estimate of 0.75 described above, we therefore adopt an estimate for $\beta_{ew}$ of 0.75.

In summary, my parameter estimates are $I_e$ = 0.016, $\phi_w$ = .051, $\phi_S$ = 0.063, and $\beta_{ew}$ = 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 (10), (11) and (12) 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: $k_e = .03 + .06(1) - .016(0) = .090$

[28] 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.

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 (14) and the application of market-wide parameter values for $I_e$ and $\beta_{ew}$ 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 $\beta_{ew}$, which I estimate at 0.75 for the Australian market in aggregate, I consider a range of values from 0.65 to 0.85.[29] Finally, in respect of the variance ratio shown in equation (14) and estimated at 0.80, I consider a range of values from 0.70 to 0.90, implying a range of values for $\phi_w$ from .045 to .055 (and associated values of $\phi_S$ from .065 to .062).

Table 3 below shows the results from equations (11), (12) and (10) in that order, for this range of values for $I_e$, $\phi_w$, $\phi_S$ and $\beta_{ew}$, along with an estimated value for $U$ of 0.625.[30] 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

| Model | $\phi_w$ | $\phi_S$ | $\beta_{ew}$ = .65 | | | $\beta_{ew}$ = .75 | | | $\beta_{ew}$ = .85 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $I_e$ = .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 |
| 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

[29] 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).

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

decline. With an estimate for $U$ of 0.35, as advocated by the Australian Competition Tribunal (ACT, 2011) and 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.[31]

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

| Model | $\phi_w$ | $\phi_S$ | $\beta_{ew}$ = .65 | | | $\beta_{ew}$ = .75 | | | $\beta_{ew}$ = .85 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $I_e$ = .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 |
| 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 |

[31] If the Officer model in equation (10) used an estimate of the market risk premium that prevailed under market segmentation, equation (10) would coincide with equation (11) and all sources of conflict would then be eliminated.

In summary, the use of the Officer model is inconsistent with an estimate of the utilisation rate on imputation credits that is less than 1 because the Officer model assumes that national equity markets are segmented whilst an estimate of the utilisation rate on imputation credits of less than 1 reflects the presence of foreign investors. In the face of this inconsistency, 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, in using an estimate for *U* that is significantly less than 1, the approach generally employed by Australian regulators fails this test in virtually every case examined, and is therefore deficient. In effect, combining Officer's CAPM with a utilisation rate that is significantly less than 1 constitutes a de facto 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.

*3.8 Summary*

In summary, there are five possible approaches to estimating the utilisation rate. The first of these arises from the definition of this CAPM 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 - 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, because of the tax regime change at that point allowing rebates for unused credits, 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 considered to be 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 the estimate is reasonably precise. The first approach described in the previous paragraph satisfies all of these requirements and is therefore recommended. The second approach described in the previous paragraph satisfies the first and third of these requirements, but not the second in the sense that its associated estimate of *U* would give rise to implausibly high costs of equity, and is therefore ranked second. The third approach (the proportion of credits redeemed with the tax authorities) satisfies only the first of these requirements, and is therefore ranked third. The fourth approach (using market prices) satisfies none 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 methodology generates a wide range of estimates depending upon the specific methodology and data used. For example, in SFG's dividend drop-off study, the deletion of less than 1% of the outliers selected using one particular methodology almost doubles the estimated value of *U*. The estimates from the dividend drop-off studies may also reflect broader anomalies unrelated to tax issues, the actions of a small and unrepresentative set of investors, and are exposed to microstructure effects such as the bid-ask bounce. The fourth approach 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 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 much lower weighting than on the other methods and therefore an estimate for *U* of about 0.80.

## 4. Estimating the Distribution Rate

*4.1 Theory-Based Estimates*

The AER (2009, page 410) argues for a distribution rate of 1 on the basis that full distribution of free cash flows is the standard assumption for valuation purposes (AER, 2009, page 410). 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. This implies use of an empirically determined distribution rate rather than one arising from standard valuation assumptions.

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.

Handley (2009, section 2) also argues for a distribution rate of 1 on the basis that the progressive build up in undistributed credits will eventually attract the attention of corporate raiders etc, and that history has shown that financial markets are innovative when the incentives are large. 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 (6). 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.

*4.2 Empirically-Based Estimates*

The generally employed estimate of the distribution rate is 70%, based upon an examination of data from the ATO. For example, Hathaway (2010, page v) offers an estimate of 69%, and Hathaway (2013, page 7) raises this slightly to 71%. In addition, NERA estimates it as 69% since 1996 and 70% in the last five years (NERA, 2013a, Table 2.2). These estimates are broadly consistent. However this approach yields a market average. By contrast, within the Officer (1994) model, the distribution rate is a firm specific parameter rather than a market average parameter.

The fact that this parameter is firm specific within the Officer model points to the use of data from individual firms, either tailored to each firm or averaged over some set of firms. However, firm-specific estimates 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 be an industry average. In this case, the natural choice for the purposes of the QCA would be the largest businesses that are subject to regulation or monitoring by them. However most of these are publicly owned and do not pay dividends. This points to examining a set of large private-sector Australian firms that contain significant regulated businesses. The natural choice here would be energy businesses. However the set of firms is not large and therefore the choice of whether or not to include certain marginal cases (and how many years' data to include) is likely to materially affect the resulting estimate. These difficulties are absent from the market-wide data, because all firms are included and the evidence suggests that the distribution rate is not materially different according to the choice of historical period. 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.[32] 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.

[32] 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.

*4.3 The Choice of Market-Level Data*

A further issue is in the type 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 most valuable Australian companies, using data from their Annual Reports. I therefore focus upon the ten largest ASX companies, which comprise 50% of the ASX200 market capitalisation.[33]

The first issue is that of how much historical data to use, with more data yielding a more precise estimate but raising the risk of bias arising from data that is not recent being unrepresentative of the current situation. Furthermore, the availability of the data tails off from about 2000. I therefore use data since 2000. The distribution rate is the distributions as a proportion of the tax payments to the ATO. The distributions can be deduced from the fully franked dividends and the corporate tax rate over this period:

$$DIST = DIV\left(\frac{T_c}{1-T_c}\right) \tag{15}$$

The dividend payments, and the part that is fully franked, can be obtained from the "Dividends" note to the financial statements. The tax payments to the ATO are less obvious because the tax payments shown in the "Cash Flow Statement" will include payments to foreign tax authorities and separate identification of the payments to the ATO is not generally made in financial statements. However, over the period examined (2000 to 2013), the franking balance of the entity will have changed due to tax payments to the ATO and distributions of credits via dividends:

$$B_{2013} = B_{2000} + TAX - DIST$$

The tax payments to the ATO will then be as follows:

[33] These companies are CBA, BHP Billiton, Westpac, ANZ, NBA, Telstra, Woolworths, Wesfarmers, CSL and Woodside Petroleum. The market rate is the aggregate distributions over all companies divided by their aggregate tax payments to the ATO, and companies with the highest market value are likely to make the greatest contribution to this.

$$TAX = DIST + B_{2013} - B_{2000} \tag{16}$$

The distribution rate is then the ratio of (15) to (16). There is typically a choice in dividend data between the parent company and the group, although the difference is generally small. However the franking balance is typically only given for either the parent or the group. So, if the franking balance is given only for the parent, the entire analysis is done using data for the parent. Where choice is available, I conduct the analysis at the group level.

The results are shown in Table 5 below (figures in $m).[34] For example, for CBA, parent data is used. The "Franking Balance" (found in the "Dividends" note to the accounts) grows from $450m to $742m over the period. Fully franked dividends of $35,496m were paid over the period, implying distributed credits of $15,212 using equation (15). Using equation (15), the tax payments to the ATO are then $15,504m. The distribution rate is then $15,212/$15,504m = 0.98. These rates range from 53% (Woodside) to 100% (Telstra). The market distribution rate is the aggregate distributions (*DIST*) divided by the aggregate taxes paid to the ATO (*TAX*), of 85%, as shown in the last row of Table 5.

The estimates of *TAX* shown in Table 5 can be tested in a number of ways. Firstly, such values should not materially exceed the tax payments for each firm, as shown in the "Cash Flow Statement". This test is satisfied in all cases. Secondly, wherever data is available on the tax payments to the ATO, the estimate shown in Table 5 should closely correspond to it. The ANZ discloses the tax payments made to the ATO (as well as the total tax payments) in its "Cash Flow Statement" for some years. For these years the proportion is 70%, and application of the same rate to the total tax payments in other years coupled with the ATO payments that are disclosed yields an estimate of the total tax payments to the ATO for 2000-2013 of $13,681; this is close to the estimate of $13,015 shown in Table 5. Lastly, where the "Tax Expense" shown in the financial statements is split between Australia and other countries, application of the ratio (Australia to total) to the tax payments shown in the "Cash Flow Statement" should yield an estimate of the tax paid to the ATO that closely corresponds to the estimate shown in Table 5.

[34] The data shown in BHP's annual reports are all in US$, and are converted to AUD using the average exchange rate for the month to which $B_{2013}$ relates (December 2012) and the average rate during the year for the dividend payments. In addition, the data shown in Woodside's financial statements for the years ending 2009-2012 inclusive are also in US$, and are treated in the same way. In addition, CSL data extends back only to 2004.

Table 5: Distribution Rates for Companies and the Market

| Company | $B_{2000}$ | $B_{2013}$ | *DIV* | *DIST* | *TAX* | *DIST RATE* |
|---|---|---|---|---|---|---|
| CBA (Parent) | 450 | 742 | 35,496 | 15,212 | 15,504 | 0.98 |
| BHP (Group) | 0 | 11,308 | 46,794 | 20,054 | 31,362 | 0.64 |
| Westpac (Parent) | 257 | 1247 | 34,964 | 14,984 | 15,974 | 0.94 |
| ANZ (Group) | 0 | 265 | 29,750 | 12,750 | 13,015 | 0.98 |
| NAB (Group) | 0 | 1035 | 31,291 | 13,410 | 14,445 | 0.93 |
| Telstra (Group) | 74 | 0 | 45,255 | 19,395 | 19,321 | 1.00 |
| Woolworths (Group) | 417 | 1943 | 11,621 | 4,980 | 6,506 | 0.77 |
| Wesfarmers (Group) | 0 | 243 | 12,602 | 5,400 | 5,643 | 0.96 |
| CSL (Group) | 0 | 0 | 377 | 161 | 161 | 1.00 |
| Woodside (Group) | 173 | 3,260 | 8,034 | 3,443 | 6,530 | 0.53 |
| Total | | | | 109,759 | 128,461 | 0.85 |

In conclusion, given the difficulties in the ATO data, my preference is for the financial statement data for companies and this points to a market-level distribution rate of 85%.

*4.4 The Use of Historical Data*

All of these empirically-based 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 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.

### *4.5 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. Such data is available from the ATO but there are concerns about it. Accordingly I favour an estimate using data from the financial statements of the ten largest ASX companies, and data for the period 2000-2013 is used. 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. Using the aggregate distribution rate of the ten largest ASX companies over the period 2000-2013, the estimated market-level distribution rate is 85%.

## 5. Review of SFG

### *5.1 The Distribution Rate*

SFG (2012, section 3) favours a distribution rate of 70% based upon evidence of the type presented by Hathaway (2010). This is consistent with estimates based upon ATO data, as discussed in section 4.2. However, NERA (2013a) acknowledges difficulties in this data. Accordingly, I favour results based upon an examination of the largest ASX companies and this points to a distribution rate of 85%.

### *5.2 The Utilisation Rate*

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

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

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 legally use the credits do not use them. However, some schemes may still exist by which investors who can't legally use the credits themselves transfer them to others who can, and share the benefits with them (McKenzie and Partington, 2011, page 9). 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 not because those who can use the credits have a utilisation rate of less than 1. However, as discussed in section 3.3, the legislative rules that discourage such temporary transfers of shares are extensive and are likely to have significantly curtailed such activity, in which case the upward bias should not be great.

SFG (2012, pp. 9-11) argue for a utilisation rate of 0.35 based upon the results from SFG (2011). However, as discussed in section 3.4, the estimate should have been about 0.40 and there are a number of limitations in studies of this type, which cast considerable doubt upon their results.

SFG (2012, pp. 10-12) acknowledge that there is variation in estimates of *U* from different dividend-drop-off studies but asserts that 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, i.e., the 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 SFG (2011), the implied estimate for *U* is 0.41 as follows:

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

whilst the implied estimate from Beggs and Skeels (2006) is 0.72 as follows

$$U = \frac{0.572}{0.80} = 0.72$$

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.

SFG (2012, page 12) also cite Cannavan et al (2004), who estimate *U* using simultaneous prices for shares and futures contracts, in support of an estimate for *U* of zero. However this is a long way from SFG's recommended estimate of 0.35, which should be 0.41 as described above, and further still from the estimate of 0.72 arising from Beggs and Skeels described above. Furthermore, despite SFG's study using data since July 2001 for the very good reason that a relevant change in the tax regime occurred at that time, they neglect to mention that the Cannavan et al (2004) study uses data from before that tax regime change. Furthermore, they neglect to cite a similar study using data since July 2001 (Cummings and Frino, 2008), which yields estimates of $U$ of 0.63 and 0.65. All of this highlights the fact that estimates of $U$ based upon market prices produce a wide range of estimates, which undermines the credibility of all such estimates.

SFG (2012, section 6) argues that standard market practice in Australia is to ignore imputation credits when valuing assets or estimating the corporate cost of capital. They cite KPMG (2005) in support of the claim that independent expert valuation reports ignore imputation credits, and Truong et al (2008) in support of the claim that the majority of CFOs of major Australian companies also ignore imputation credits in assessing projects. These claims have been assessed in section 3.5, and do not support the conclusion that $U = 0$. Furthermore, SFG neglect to cite KPMG (2013), which presents quite different results. SFG (2012, section 6) also 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 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.

SFG (2012, section 7) notes that the AER 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. Given this, they claim that *U* must be zero because empirical studies consistently find that the combined value of dividends with maximum imputation credits is $1 per $1 of cash dividends.

I disagree with this line of argument for the following reasons. Firstly, SFG's beliefs are internally inconsistent, in simultaneously asserting that imputation credits are worthless (here), that the combined value of dividends with maximum imputation credits is $1 per $1 of cash dividends (here), 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. Secondly, 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.

Thirdly, the claim that empirical studies consistently find that the combined value of cash 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 (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. Thirdly, if it were true that the combined value was $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 is that dividends are valued less than capital gains. For example, in respect of dividend drop-off studies, 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 3.4, 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), which examines 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, and Cliffe and Marsden, 1992). 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.

SFG (2012, section 8) observes that the general practice in estimating WACC parameters is to draw upon market evidence, and to weight evidence in accordance with its statistical precision and economic reasonableness. I agree. In respect of "economic reasonableness", and as discussed in section 3.7, estimates of *U* below 0.80 should be viewed unfavourably because in conjunction with the Officer CAPM they lead to estimates of the cost of equity that are too high in the sense of lying above the range of values resulting from complete segmentation and complete integration. In respect of statistical precision, and as discussed in section 3.4, the statistical precision of recent estimates of *U* using market prices is so low that SFG's (2013) estimate of 0.40 is not statistically distinguishable from Cummings and Frino's (2008) estimate of 0.64. Additional criteria not mentioned by SFG are the sensitivity of results to the choice of data, the sensitivity of results to the choice of statistical methodology, and the likelihood of bias. The use of market prices scores poorly on all of these criteria. In particular, and as discussed in section 3.4, the results from dividend drop-off studies are very sensitive to the choice of data, regression method, and the treatment of outliers. Finally, as discussed in section 3.4, an estimate of *U* from any methodology that uses market prices is likely to reflect the actions of an unrepresentative subset of investors, and is therefore inconsistent with the definition of $U$ as a weighted average across all investors; this is bias.

SFG (2012, para 100) also 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 $U$. 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, i.e., lie within the range of values resulting from complete segmentation and complete integration of equity markets. As shown in section 3.7, this requirement is not satisfied for values for $U$ that are significantly below 1, and the result of using such values is an implausibly high cost of equity that effectively arises from choosing both the model and the value for $U$ that is most favourable to the regulated businesses.

## 6. Conclusions

My principal conclusions are as follows. In respect of the imputation utilisation rate, 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 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, because of the tax regime change at that point allowing rebates for unused credits 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 considered to be 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 the estimate is reasonably precise. The first approach described in the previous paragraph satisfies all of these requirements and is therefore recommended. The second approach described in the previous paragraph satisfies the first and third of these requirements, but not the second in the sense that its associated estimate of *U* would give rise to implausibly high costs of equity, and is therefore ranked second. The third approach (the proportion of credits redeemed with the tax authorities) satisfies only the first of these requirements, and is therefore ranked third. The fourth approach (using market prices) satisfies none 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 methodology generates a wide range of estimates depending upon the specific methodology and data used. For example, in SFG’s dividend drop-off study, the deletion of less than 1% of the outliers selected using one particular methodology almost doubles the estimated value of *U*. The estimates from the dividend drop-off studies may also reflect broader anomalies unrelated to tax issues, the actions of a small and unrepresentative set of investors, and are exposed to microstructure effects such as the bid-ask bounce. The fourth approach 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 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 much 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. Such data is available from the ATO but there are concerns about it. Accordingly I favour an estimate using data from the financial statements of the ten largest ASX companies, and data for the period 2000-2013 is used. 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. Using the aggregate distribution rate of the ten largest ASX companies over the period 2000-2013, the estimated market-level distribution rate is 85%.

Finally, in respect of SFG’s most recent arguments concerning the utilisation rate, I disagree with these arguments. Their most significant argument is that there is an inconsistency in the AER believing that the value of (unfranked) dividends relative to capital gains is about 0.80 and also using the Officer CAPM (which assumes that unfranked dividends and capital gains are equally valued), and this inconsistency should be eliminated by treating the ratio of unfranked dividends to capital gains at 1, on the grounds that it allows continued use of the Officer CAPM, and therefore *U* must be treated as zero because empirical studies consistently find that the combined value of dividends with maximum imputation credits is $1 per $1 of cash dividends. I agree that there is an apparent inconsistency between the unfranked dividend-to-capital gain ratio and the Officer CAPM. However SFG's beliefs are 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. Furthermore, one should not choose a parameter value (the unfranked dividend-to-capital gain ratio) simply because it is consistent with a model that is currently in use, nor is it true that empirical studies consistently find that the combined value of cash and imputation credits is $1 per $1 of cash dividends.

The empirical evidence on the dividend-to-capital gain ratio, from both dividend drop-off studies and other empirical work, points to the desirability of an alternative CAPM to that of Officer, so as to recognise the differential taxation of ordinary income and capital gains. 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.

## APPENDIX

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.[35] 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

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

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

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

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

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 (10).

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