THE ESTIMATED UTILISATION RATE FOR IMPUTATION CREDITS

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EXECUTIVE SUMMARY

This paper has addressed a number of issues raised by the QCA relevant to the estimation of the utilisation rate on imputation credits (U), including the merits of a recent estimate by SFG. The conclusions are as follows.

I have a number of theoretical concerns about SFG's approach to estimating the utilisation rate. Firstly, SFG mistakenly equate the utilisation rate with the coefficient on franking credits in their regression model rather than with this coefficient divided by the coefficient on cash dividends, and the effect of this point is that SFG's estimated utilisation rate of 0.35 should instead be about 0.40. Secondly, although the utilisation rate is a weighted average over all investors in the market, the dividend drop-off approach used by SFG will tend to reflect the tax position of tax arbitrageurs and these investors may be only a small proportion of the entire market. Thirdly, many dividend drop-off studies have identified various anomalies that cannot be attributed to any kind of tax explanation and therefore SFG's 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. Fourthly, SFG do not include a constant in their regression model; the case for doing so is neither presented nor clear cut, some earlier studies yield a statistically significant constant, and its omission could materially alter the estimate for the utilisation rate. Fifthly, SFG's approach to estimating the utilisation rate for insertion into the Officer version of the CAPM also suggests 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 the results of SFG's study in conjunction with the Officer CAPM.

In relation to SFG's treatment of data, SFG's process for selecting observations involves deleting those 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.

In relation to the statistical robustness of SFG's results, SFG favour the results from their Model 4 and also those from robust regression, which reduces the weight on more volatile observations. This produces a relatively narrow band of estimates of the utilisation rate from 0.29 to 0.43. However, SFG's tests for the best model are inadequate, and Model 4 could not in any event be clearly judged to be superior to Model 2 because the standard deviations of stock returns used in Model 4 are subject to estimation error. In the absence of adequate tests for the best model, the admissible range of estimates for the utilisation rate is 0.16 to 0.59, and therefore SFG's results are not statistically robust. Even if these tests favoured Model 4, Model 2 would still be a candidate because the standard deviations of stock returns used in Model 4 are subject to estimation error; the range of estimates for the utilisation rate would then be from 0.29 to 0.59. Even this is a very wide band and the upper limit of 0.59 is only trivially different from the estimate for the utilisation rate of 0.60 that is generally employed by Australian regulators.

In respect of whether SFG's conclusion (that the utilisation rate on imputation credits is 0.35) is consistent with their statistical findings, SFG confuse the utilisation rate with one of their regression parameters and therefore underestimate the utilisation rate (by 0.05). In addition, SFG's preference for Model 4 over other models is based upon inadequate tests and, even if those tests favoured Model 4, they ought to have still given significant weight to the results from their Model 2, and doing so significantly widens the range of estimates for the utilisation rate, from 0.29 to 0.59. Consequently, SFG's estimate of 0.35 for the utilisation rate is not consistent with their findings.

In respect of differences between SFG's study and earlier studies, there are three principal points of difference. Firstly, SFG's study uses data from July 2000 (the time of the last tax legislation change that could affect the estimated utilisation rate) to 2010 whilst the most recent of the earlier studies uses data only up to 2004, and this alone could explain the difference in results across the studies. Secondly, in addition to presenting results using the traditional scalar of price, SFG also scales observations by the inverse of the estimated standard deviation of stock returns, and also invokes the "robust regression" method. The use of the estimated standard deviation significantly lowers the estimate of the utilisation rate, and this estimate may be less reliable because of errors in estimating the standard deviations, whilst the impact of robust regression on the estimated utilisation rate is much less significant. Finally, unlike most earlier studies, SFG do not include a constant in their regression models.

The case for doing so is neither presented nor clear cut, some earlier studies yield a statistically significant constant, and its omission could materially alter the estimate for the utilisation rate.

My overall conclusion on SFG's study is that it is subject to a number of theoretical concerns, of which the most significant are the omission of a constant from their regression model, the potential impact of tax arbitrageurs on their results, and the fact that many studies have identified various anomalies on or around dividend ex-day that cannot be attributed to any kind of tax explanation. SFG's analysis has also eliminated a potentially large set of valuable observations, without any explanation or sensitivity analysis, and the evidence from other studies suggests that the inclusion of these observations could materially alter SFG's results. In addition SFG's preference for Model 4 is not supported by the tests they have conducted and, even if more appropriate tests were conducted and still supported Model 4, the results from Model 2 would still warrant significant weight, leading to a wide range of estimates of the utilisation rate, ranging from 0.29 to 0.59. The omission of the constant and the exclusion of a potentially large number of observations without any explanation or sensitivity analysis could be addressed. However, even if they were, the remaining problems are sufficiently severe that they should discourage reliance upon the study. In any event, if any reliance were placed upon SFG's study, the fact that it also suggests that unfranked dividends are valued less highly than capital gains (and therefore contradicts the Officer version of the CAPM) raises significant concerns about using the results of SFG's study in conjunction with Officer's version of the CAPM.

In relation to a potential inconsistency between market-based estimates of the utilisation rate and the use of the Officer version of the CAPM, the inconsistency arises because the Officer model assumes that national equity markets are segmented whilst a market-based estimate of the utilisation rate reflects the presence of foreign investors. In the face of this inconsistency, a minimum requirement is that the cost of capital results from this approach (inclusive of the effective reduction in company taxes) 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, 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 of 0.60 rather than 1 constitutes a form of cherry-picking parameter values and models so as to maximise 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, the test described here would be satisfied in most cases.

In relation to the range of possible approaches to estimating the utilisation rate, there are six possibilities. The first of these arises from the definition of the parameter (as a weighted average over the utilisation rates of individual investors) coupled with ignoring foreigners, and 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 0.54 (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 0.81. The remaining three possibilities use market prices, from simultaneous cum and ex-dividend share prices, simultaneous share and futures prices, and share prices before and after ex-dividend day. Only the latter approach has been applied to post July 2000 data, by SFG, and yields an estimate of 0.29 to 0.59. However, in respect of the last three approaches, a comparison of the estimates using data before July 2000 reveals dramatic differences across methodologies, from 0.15 to 0.88 in one period and from -0.02 to 0.53 in another period. In my view, the most important considerations in selecting a methodology are that the estimate be consistent with the definition of the utilisation rate and that the parameter estimate maximises the chance that the estimated cost of equity from the Officer model lies within the bounds arising from either complete segmentation or complete integration of equity markets. The first approach satisfies both of these requirements and is therefore recommended (U = 1). The second approach satisfies the first of these requirements, and is therefore ranked second (U = 0.54). The remaining approaches satisfy neither requirement. However, all three approaches that use market prices produce dramatically different estimates, presumably because they are driven by different subsets of investors or are subject to some unknown anomaly or microstructure feature. By contrast, the third approach (the proportion of credits redeemed with the tax authorities) is at least free of this problem. I therefore rank this approach third (U = 0.81), and all three approaches that use market prices are ranked last.

Finally, the tax positions facing State government-owned businesses and privately-owned businesses are significantly different and this gives rise to the question of whether to use the same utilisation rate for both types of businesses. One approach would be to assign a utilisation rate of zero to State government-owned businesses because they do not issue imputation credits and non-issue is equivalent to a utilisation rate of zero. However, this approach fails to consider the broader tax differences between the privately-owned and State government-owned firms and is also inconsistent with the definition of the utilisation rate within the Officer model as uniform across all firms. A second approach would be to assign a utilisation rate of 1 to the State government-owned businesses on the grounds that they face only one layer of tax and a utilisation rate of 1 is consistent with this. However such an approach assumes that the average personal tax rate matches the corporate rate and is also inconsistent with the definition of the utilisation rate within the Officer model as uniform across all firms. A third approach would be to hypothesise a business whose tax position is equivalent to that of the State government-owned businesses in substance and also consistent with the Officer model, and then treat the State government-owned businesses in the same way as this hypothetical business; this would lead to applying the same utilisation rate to both privately-owned and State government-owned businesses. In addition to these conceptual issues, any approach that yields different price caps for the two types of firms will give rise to a lack of equity across the customers of both types of businesses. Also, any approach that produces a lower price cap for the State government-owned businesses would raise demand for, and therefore the output of, these State government-owned businesses at the expense of the private sector (with the extent of the output effect depending upon the price elasticity of demand and the extent of direct competition by private-sector firms). Finally, if State government-owned businesses are assigned a utilisation rate less than 1 when the true utilisation rate is 1, and therefore the rate of return allowed by the regulator is set too high, there may be an incentive for them to overinvest. In view of these complexities, the appropriate utilisation rate for State government-owned businesses is not clear and I therefore favour further analysis of this issue.

1. Introduction

In October 2010, the Australian Competition Tribunal (2010, para 145) determined that the AER had erred in estimating the utilisation rate for imputation credits in its May 2010 final decisions on electricity distribution for 2010-2015 for Queensland (Energex and Ergon Energy) and South Australia (ETSA Utilities). Consequent upon this, the Tribunal instructed the AER to engage SFG to undertake a dividend drop-off analysis on the basis of Terms of Reference agreed between the AER and SFG (ibid, paras 146-147). The outcome of this was the report from SFG (2011). Accordingly the QCA has asked me to undertake the following tasks:

- review the report by SFG (2011), by summarising previous studies, reviewing SFG's theoretical framework, reviewing SFG's treatment of the data, reviewing SFG's application of the methodology to the data, assessing the statistical robustness of their results, assessing the consistency of their conclusion with their results, comparing SFG's results with those of earlier studies, and assessing whether SFG's study should be exclusively relied upon to estimate the utilisation rate; and
- assess whether market-based estimates of the utilisation rate are inconsistent with the Officer (1994) version of the CAPM, because the former will reflect the presence of foreign investors whilst the latter assumes that they are not present; and
- assess whether State government-owned and privately-owned businesses should be subject to the same estimate for the utilisation rate.

2. Review of SFG

2.1 SFG's Analysis

SFG (2011) estimates U by examining share price changes around divided ex-days for Australian companies over the period from 1.7.2000 to 30.9.2010, subject to exclusion of some observations. In respect of the remaining approximately 3000 observations, SFG conduct a series of regressions (models 1…4). 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):

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

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 σ_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 δ as the market value per $1 of unfranked dividends and θ as the utilisation rate (U).

SFG also apply a modified regression process ("robust regression"), which automatically reduces the weight on extreme observations, and further check for the effect of excluding certain price sensitive announcements. The result is a series of estimates for δ and θ, shown in their Tables 5 to 8 with estimates of δ ranging from .80 to 0.93 and estimates of θ ranging from 0.08 to 0.48. SFG conclude with an estimate of 0.85-0.90 for δ and 0.35 for θ (ibid, para 102).

2.2 Previous Studies

A number of previous studies of this type have been undertaken using Australian data, as follows. Brown and Clarke (1993) use data from 1989-1991 and conduct the following regression:

$$\frac{P_{it-1}^* - P_{it}}{P_{it-1}} = \alpha_1 + \alpha_2 \frac{DIV_i}{P_{it-1}} + \alpha_3 \frac{FC_i}{P_{it-1}} + \varepsilon_i \tag{2}$$

where P_{it-1}^* is the cum-dividend price adjusted for the market return over the interval from the cum to the ex-dividend stock price. Relative to SFG (2011), they do not scale their variables by the standard deviation of each stock, they deal with market movements over the interval between the cum and ex-dividend prices slightly differently, and they also insert a constant into their model (α_1) that has no counterpart in SFG's work. They obtain estimates for α_2 and α_3 of 0.88 and 0.46 respectively (ibid, Table 7). Letting T_c denote the corporate tax rate (39%

at the time) they go on to assert that the implied estimate for U is 0.82 as follows (ibid, footnote 39):[1]

$$U = \frac{\alpha_3(1-T_c)}{\alpha_2 T_c} = \frac{0.46(1-0.39)}{0.88(0.39)} = 0.82 \tag{3}$$

Bruckner et al (1994) use data from 1990-1993, and employ a minor variant of equation (2) above:

$$\frac{P_{it-1} - P_{it}^*}{P_{it}^*} = a + b\frac{DIV_i}{P_{it}^*} + c\frac{FC_i}{P_{it}^*} + \varepsilon_i \tag{4}$$

Relative to equation (2), Bruckner et al scale by the market-adjusted ex-dividend price rather than the cum-dividend price, and they also perform the market adjustment to the ex-dividend price rather than the cum-dividend price. Their estimates for b and c are 0.62 and 0.68 respectively (ibid, Exhibit 14). Bruckner et al equate the coefficient c with the utilisation rate (ibid, Exhibit 13).

Hathaway and Officer (2004) use data from 1986-2004 and conduct the following regression:

$$\frac{P_{it-1} - P_{it}}{P_{it-1}} = a\frac{DIV_i}{P_{it-1}} + b\frac{DIV_i}{P_{it-1}} f_i + cR_{mt} + \varepsilon_i \tag{5}$$

where f is the franking ratio (FC/DIV as a proportion of its maximum possible value). Their equation (5) above is very similar to Brown and Clarke's equation (2) above, differing in substance only through the absence of the constant and dealing with market movements between the cum and ex-dividend prices by adding an additional explanatory variable rather than by adjusting the cum-dividend price. The resulting estimates of a and b are 0.80 and 0.27 respectively (ibid, Table 3) and (coupled with a prevailing corporate tax rate of 36%) the authors assert that the implied estimate of U is

$$U = \frac{b(1-T_c)}{T_c} = \frac{0.27(1-0.36)}{0.36} = 0.49 \tag{6}$$

[1] This will be explained more in section 2.3 below.

Beggs and Skeels (2006) use data from 2001-2004 and conduct the following regression:

$$P_{it-1} - P_{it}^{*} = \gamma_0 + \gamma_1 D_i + \gamma_2 F_i + \varepsilon_i \quad (7)$$

Their equation (7) above differs from Brown and Clarke's equation (2) above only in not scaling the variables by the cum-dividend price, and performing the market adjustment on the cum rather than the ex-dividend price. Their estimates for γ_1 and γ_2 are .800 and 0.572 respectively (ibid, Table 5).

2.3 Review of SFG: Theory

I have a number of concerns about SFG's theoretical framework, relevant to all four models considered by them, as follows. Firstly, SFG's equation (1) above can be expressed as follows:

$$P_{it-1} - P_{it}^{*} = \delta D_i + \theta FC_i + u_i \quad (8)$$

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

$$P_{it-1} - P_{it}^{*} = \delta[D_i + FC_i] + u_i \quad (9)$$

where δ would recognise that the expected price change might differ from the gross dividend (because the tax rate on gross dividends differs from that on capital gains for many investors). However some investors cannot use the credits at all and this should be dealt with by multiplying *FC* by a coefficient *U* that represented some kind of average utilisation rate. Equation (9) would then become

$$\begin{aligned} P_{it-1} - P_{it}^{*} &= \delta[D_i + U(FC_i)] + u_i \\ &= \delta(D_i) + \delta U(FC_i) + u_i \quad (10) \end{aligned}$$

Dividing through by the cum-dividend price and the standard deviation (for reasons described in section 2.1) then yields

$$\frac{P_{it-1} - P_{it}^*}{P_{it-1}\sigma_i} = \delta \frac{D_i}{P_{it-1}\sigma_i} + \delta U \frac{FC_i}{P_{it-1}\sigma_i} + \varepsilon_i \tag{11}$$

Comparison with SFG's equation (1) above then reveals that $\theta = U\delta$ and therefore that

$$U = \frac{\theta}{\delta} \tag{12}$$

By contrast, SFG clearly treat the regression coefficient θ as the utilisation rate. The numerical effect of this is that, having estimated θ at 0.35, SFG then estimate U as 0.35. However, following equation (12) with SFG's estimate for δ of 0.85-0.90, SFG should have estimated U as 0.35/0.875 = 0.40. Put another way, the coefficient θ reflects both the ability of investors to use the credits and the value of the credits when they are fully usable, and the latter is indistinguishable from the value of cash dividends and this is reflected in the coefficient δ (of 0.85-0.90). Thus, treating the estimate of θ as an estimate of U will underestimate U. Put yet another way, imagine a world in which $U = 1$. In such a world, the coefficient θ will match that of δ, and the latter appears to be less than 1. So, in such a world, θ will underestimate U.

This problem is not peculiar to SFG. Bruckner et al mistakenly equate the coefficient c in equation (4) above with the utilisation rate rather than c/b, and the effect is to mistakenly estimate U at 0.68 rather than 0.68/0.62 = 1.10.[2] In addition, in equation (6) above, Hathaway and Officer fail to divide by the coefficient a, and therefore mistakenly estimate U at 0.49 rather than 0.61. Beggs and Skeels never assert that the coefficient γ_2 in equation (7) above is equal to the utilisation rate but their estimate of 0.572 for γ_2 has been widely interpreted as an estimate for U. Paralleling equation (12), the correct estimate for U is in fact γ_2/γ_1 = 0.72. Only Brown and Clarke correctly recognise this point in their equation (3)

[2] Clearly, the utilisation rate cannot be in excess of 1 and therefore the estimate of 1.10 should either be disregarded or adjusted down to 1. Equally, the coefficient c cannot be larger than the coefficient b, and yet the estimate of c exceeds that of b. Remarkably, this implausibility in their results did not prompt any comment from the authors.

above but the corporate tax terms are mistakenly included in the formula and their omission would give rise to an estimate for U of 0.52 rather than 0.82.[3]

Secondly, the utilisation rate U that SFG seek to estimate is a parameter within the Officer (1994) version of the CAPM, which is generally employed by Australian regulatory bodies. Since this utilisation rate varies across investors (one for those who can fully use the credits and zero for those who can't), 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. Accordingly, U could change day-by-day as the composition of investors changes but regulatory applications of the Officer model adopt a uniform value for U over the regulatory cycle and therefore implicitly average across any day-to-day variations (as with the market risk premium). By contrast, the results from dividend drop-off studies may tend to reflect the composition of only shareholders around ex-dividend day and this may be significantly different to that at other times due to "tax arbitrage". For example, in the presence of variation in tax rates over investors on dividends relative to capital gains, and also variation in the ability to use imputation credits, some investors may buy equities shortly before ex-dividend days and sell afterwards because the post-tax payoffs to them from holding the stock over this period are particularly favourable whilst the parties on the other side of these transactions will have the opposite tax position and therefore also benefit (the loser being the tax authorities).

This tax-arbitrage argument was first presented by Kalay (1982) and it has a number of testable implications. In particular, trading volume will be higher around ex-dividend days, it will be positively related to dividend yield and it will be negatively related to transactions costs. These predictions have all been confirmed in the US by Lakonishok and Vermaelen (1986) and Michaely and Vila (1996); the latter show that volume is twice the normal level in the 11 days around ex-day for stocks in general and 17 times normal volume for stocks with

[3] Hathaway and Officer also have these corporate tax terms in their equation (6) above but this is justified by the different formulation of their regression equation (5) above.

high dividend yields and low transaction costs (ibid, pp. 481-485). Further testable implications relate to abnormal returns on ex-dividend days: these abnormal returns will change if transactions costs significantly change and they will be related to the tax rates to which tax arbitragers are subject. Naranjo et al (2000) test these predictions by examining the ex-dividend day returns for US stocks with very high dividend yields and other features that facilitate tax arbitrage, they find that the returns shift from positive in the 20 years preceding the 1975 introduction of negotiated commissions to negative in the following 20 years, and they attribute this to tax arbitrage after 1975 by corporates (who face lower taxation on dividends than on capital gains). They also found that the post 1975 ex-dividend day returns are negatively related to the tax advantage of dividends over capital gains for corporates, consistent with tax arbitrage by corporates. Eades et al (1984) also find negative ex-day returns for preferred stock, which have high dividend yields. These negative ex-day returns for high dividend yield stocks are particularly interesting because they are consistent with ex-dividend day returns being driven by a subset of investors that constitute only about 1% of the US market (Berk and DeMarzo, 2007, page 547).

Thirdly, many dividend drop-off studies have identified various anomalies that cannot be attributed to any kind of tax explanation and this raises the possibility that ex-day behaviour is part of these broader anomalies. For example, Woolridge (1983), Grinblatt et al (1984) and Eades et al (1984) find abnormal returns on the ex-days for share splits and stock dividends for US stocks despite these events having no tax implications. In addition, Eades et al (1984) also find that excess returns on US stocks are abnormal for several days before and after dividend ex-day as well as on ex-day. Brown and Walter (1986, Table 3) find similarly anomalous behaviour in Australia. In relation to the ex-day results for share splits, Copeland et al (2005, page 666) comment that "..there is no explanation for the abnormally positive split ex-date returns..". In relation to the abnormal returns before and after dividend ex-days, Copeland et al (2005, page 666) also comment that "No good explanation for this result has yet been proposed." In respect of markets without taxes on dividends or capital gains, many studies still find positive abnormal returns on dividend ex-days: Frank and Jagannathan (1998) for Hong Kong, Milonas and Travlos (2001) for Greece, and Al-Yahyaee (2008) for Oman. Frank and Jagannathan (1998) attribute the apparently abnormal returns to prices that bounce between the bid-ask spread.[4] Al-Yahyaee et al (2008) test this conjecture in Oman and find that the abnormal returns there disappear when midpoint prices rather than transaction prices are used (thereby supporting Frank and Jagannathan's hypothesis).

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

Australian researchers have reiterated the same concerns. For example, Brown and Clarke (1993) examine dividend drop-off ratios in Australia over periods following a number of changes in tax legislation that favoured dividends over capital gains, they find results that are sometimes inconsistent with tax-based explanations for the drop-off, and they conclude that "..the tax laws are not the whole of the explanation for the ex-dividend day trade-off between dividends and capital gains." (ibid, page 36). In addition, Walker and Partington (1999) estimate the value of dividends and U by another methodology, they find markedly higher values for dividends and imputation credits through this approach, they refer to microstructure and tax arbitrage complications in interpreting results from traditional drop-off studies, and they state that "This raises the issue of whether use of the traditional drop-off ratio may lead researchers to make erroneous inferences." (ibid, page 294). In addition, Cannavan, Finn and Gray (2004, section 3.3) also seek to estimate the value of Australian imputation credits by another methodology, they note the concerns about microstructure and tax arbitrage in interpreting results from traditional drop-off studies, and conclude that "For these reasons, it is unlikely that the traditional ex-dividend day drop-off methodology will be able to separately identify the value of cash dividends and imputation credits." Remarkably, the last author here (Professor Stephen Gray) is also the lead author on the SFG report. Even

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

more remarkably, in an earlier version of the current paper, and in the course of noting disadvantages of the drop-off methodology, SFG (2008, para 90) state that "..the additional trading (around ex-dividend dates) may be driven by short-term investors seeking to capture the dividend and franking credit, affecting the resulting estimates." Thus even SFG have significant doubts about the ability of their own methodology to reliably estimate the tax effects that it seeks to.

Fourthly, SFG's equation (1) (i.e., their model 4) does not contain a constant, i.e., a term that allows for the possibility that as the (cash) dividend goes to zero the expected price change from cum to ex day (corrected for market movement) might not be zero and excluding the constant implies that this expected price change is zero.[5] The lack of any compelling reason for the expected price change, or the expected rate of return, to be non-zero as the (cash) dividend goes to zero supports exclusion of the constant. However, the empirical evidence of anomalous behaviour on the ex-days of splits and stock dividends, and also on the days shortly before and after the ex-days of cash dividends (as discussed above), suggests that the constant be included. SFG do not present any case for omitting the constant and the appropriate course of action is not clear cut. The presence or absence of the constant will affect the estimates of the other coefficients; in particular, a positive (negative) value for the constant implies that at least one of the slope coefficients would be increased (reduced) if the constant were removed.

Amongst the studies examined above in which a constant is present, Brown and Clarke (1993, Table 7) disclose the estimated value of the constant at -0.0054 and it is statistically significant. Coupled with their estimates for the slope coefficients, their model as shown in equation (2) above becomes

$$\frac{P^*_{it-1} - P_{it}}{P_{it-1}} = -0.0054 + 0.88\frac{DIV_i}{P_{it-1}} + 0.46\frac{FC_i}{P_{it-1}} + \varepsilon_i \tag{13}$$

Had the constant been removed, the estimated slope coefficients would have changed with a consequent change to the estimated utilisation rate. Bruckner et al (1994, Exhibit 14) also disclose their estimate for the constant although it is not statistically significant. Coupled

[5] SFG's Model 1 does include a constant but this does not deal with the issue in question.

with their estimates for the other coefficients, their model as shown in equation (4) above becomes

$$\frac{P_{it-1} - P_{it}^*}{P_{it}^*} = -0.001 + 0.62\frac{DIV_i}{P_{it}^*} + 0.68\frac{FC_i}{P_{it}^*} + \varepsilon_i \tag{14}$$

Again, had the constant been removed, the slope coefficients would have changed with consequent change to the estimated utilisation rate. So, in summary, SFG omit the constant, the case for doing so is neither presented nor clear cut, some earlier studies yield a statistically significant constant, and its omission could materially alter the estimate for the utilisation rate.

Fifthly, SFG's methodology is designed to estimate *U*, which is substituted into the Officer CAPM. However, by its very nature, SFG's methodology simultaneously estimates both *U* and δ and the latter reflects the tax rate on unfranked dividends relative to capital gains.[6] Thus, if one accepts the estimate of *U* from the methodology, one would also have to accept the implications of the estimate for δ (0.85 to 0.90) and this estimate implies that capital gains are taxed less heavily than unfranked dividends, which contradicts one of the assumptions underlying the Officer model (that unfranked dividends and capital gains are equally taxed). Thus, acceptance of the estimate for *U* would require rejection of the Officer CAPM in favour of a more general model that recognises this differential tax treatment (as in Lally, 1992, or Lally and van Zijl, 2003). Of course, one could reject this conclusion about the Officer model based upon the tax arbitrage and microstructure concerns noted earlier, but one could not then accept the estimate of *U* from any dividend drop-off study (including SFG's) because these same tax arbitrage and microstructure concerns contaminate conclusions from dividend drop-off studies. Put another way, estimates of δ and *U* are part of a single estimation exercise and therefore one cannot accept one and disregard the other. Interestingly, SFG (2008, para 18) shares this view about the indivisibility of the package of estimates and they go on to say that "The value of cash dividends estimated using this (drop-off) technique remains well below face value and is therefore inconsistent with the use of the CAPM.." (ibid, para 25). Remarkably, SFG favour resolving the inconsistency by continuing to use the Officer CAPM and adopting an estimate for the utilisation rate of zero (ibid, para 87). This

[6] Consider equation (1) with no franking credits. If ex-day price changes are only driven by tax effects, as SFG implicitly believe, then the parameter δ reflects the tax rate on capital gains relative to dividends, i.e., the parameter value would be 1 if the two tax rates were equal and would be less than 1 if capital gains were taxed less heavily than unfranked dividends.

involves disregarding the empirical evidence on the validity of the Officer CAPM whilst simultaneously accepting empirical evidence on *U* from the same 2008 study.

In summary, I have a number of theoretical concerns about SFG's approach to estimating the utilisation rate. Firstly, SFG mistakenly equate the utilisation rate with the coefficient on franking credits in their regression model rather than with this coefficient divided by the coefficient on cash dividends and the effect of this point is that SFG's estimated utilisation rate of 0.35 should instead be about 0.40. Secondly, although the utilisation rate is a weighted average over all investors in the market, the dividend drop-off approach may tend to reflect the tax position of tax arbitrageurs and these investors may be only a small proportion of the entire market. Thirdly, many dividend drop-off studies have identified various anomalies that cannot be attributed to any kind of tax explanation and this raises the possibility that SFG's results are at least partly caused by these broader anomalies. Both this point and the impact of tax arbitrageurs are generally recognised amongst researchers to cast doubts upon the ability of dividend drop-off studies to reliably estimate tax parameters, and these sceptics include SFG. Fourthly, SFG do not include a constant in their preferred regression model, the case for doing so is neither presented nor clear cut, some earlier studies yield a statistically significant constant, and its omission could materially alter the estimate for the utilisation rate. Fifthly, SFG's approach to estimating the utilisation rate for insertion into the Officer version of the CAPM also reveals that unfranked dividends are taxed more heavily than capital gains, and this tax differential is inconsistent with the Officer model. This inconsistency is acknowledged by SFG, and it raises significant concerns about using the results of SFG's study in conjunction with Officer's CAPM.

2.4 Review of SFG: *Treatment of Data*

The principal data issue in SFG's study is the criteria for deleting potential observations. SFG (2011, Table 1) delete over 70% of the potential observations and the primary cause for deletions is companies whose market capitalisation is less than 0.03% of the All Ordinaries Index market capitalisation. This 0.03% rule leads to deleting about 5000 observations, which is considerably more than the 3000 that are retained.[7] SFG (2011, page 60) note that this criterion is part of their Terms of Reference but they do not explain why this criterion

[7] Many of these 5000 observations may have been deleted anyway because they lack both cum and ex-dividend prices, and the requirement for both of these prices is a further (reasonable) criterion employed by SFG. So, the incremental effect of the 0.03% rule is to have removed *up to* 5000 observations.

was chosen, how the figure of 0.03% was chosen, and what effect this highly arbitrary criterion has on their estimate of the utilisation rate. Their behaviour is doubly remarkable because they provide a good deal of information on the rationale for other bases for deleting observations, they conduct numerous sensitivity tests on other issues, and in recognition of the importance of objectivity they claim that "..we do not omit any observations based upon our subjective judgement." (ibid, page 12). The ultimate source of the 0.03% rule may be Beggs and Skeels (2006, page 252), who also use this rule and argue that it eliminates companies which are rarely traded and whose pricing is therefore "not efficient". However SFG also eliminate cases where cum and ex-day prices are absent and therefore there would seem to be no incremental merit in the 0.03% rule. Furthermore, if tax arbitrage occurs in the Australian market, it is more likely to be present in large companies because of their greater liquidity. Accordingly, estimates of the utilisation rate from large companies may be different to those from small companies and the latter would be of greater interest in the present case because estimates free of the effects of tax arbitrage are more suitable. Thus, the effect of the 0.03% rule would be to exclude the superior data.

Given that SFG delete up to 5000 observations as a result of the 0.03% rule and they retain only 3000 observations, the incremental impact of the 0.03% rule on their results may be substantial. SFG (2011) provide no information on this matter but Hathaway and Officer (2004, Table 3) provide results for their entire sample, big caps stocks, mid cap stocks, and small stocks, and the differences are quite substantial. In particular, and using Hathaway and Officer's preferred equation shown as (5) above, Hathaway and Officer's implied estimates for the utilisation rate from the big cap, mid cap and small stocks are 0.61, 0.79, and -0.12 respectively.[8] These differences are very substantial and suggest that the impact on the SFG results from raising or lowering the 0.03% cut-off mark could be material.

In summary, SFG's process for selecting observations involves deleting those 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

[8] For each of the subgroups, the estimated utilisation rate is the estimated coefficient in the penultimate column of the bottom right-hand box in their Table 3 divided by the estimated coefficient in their first column (for the reasons described in the previous section). Thus, for big-cap stocks, the calculation is 0.49/0.80 = 0.61. Clearly the negative estimate of -0.12 for small stocks is not plausible.

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 affected SFG's results.

2.5 Review of SFG: *Application of the Methodology*

As indicated in section 2.1, SFG conduct a series of regressions and prefer the one they refer to as model 4 as presented in equation (1) above. By contrast, the Terms of Reference mandate a different model, which SFG refer to as Model 1 as follows:

$$\frac{P_{it-1} - P_{it}^*}{D_i} = \delta + \theta \frac{FC_i}{D_i} + \varepsilon_i \tag{15}$$

Equation (1) above arises by multiplying equation (15) above by the dividend yield of the observation and the inverse of the estimated standard deviation of the company in question. Thus, prima facie, there appears to be a conflict between the Terms of Reference and the model invoked by SFG. However there is nothing in equation (15) that requires equal-weighting on all observations, differential weighting may be statistically optimal, and SFG's equation (1) above is effectively equation (15) above subject to weighting of observations in proportion to dividend yield and the inverse of the standard deviation. Thus, SFG's preference for equation (1) over equation (15) is not in conflict with the prescribed methodology.

On other matters, SFG appears to have abided by the Terms of Reference and to have applied the prescribed methodology correctly and consistently.

2.6 Review of SFG: *Statistical Robustness of Results*

As noted in section 2.1, SFG estimate the coefficient θ after generating results from four regression models, then applying a modified regression process ("robust regression") that automatically reduces the weight on extreme observations, and further checking for the effect of excluding certain price sensitive announcements. SFG (para 93) claims that they favour the results from model 4 and robust regression, the average of the model 4 results across Tables 5 to 8 is 0.35 (with values ranging from 0.31 to 0.38), the average of the robust regression results in Table 6 is 0.34 (with values ranging from 0.27 to 0.38), and therefore they favour an estimate of 0.35.[9]

As noted earlier, the estimate of the utilisation rate is not the estimate of coefficient θ but the ratio θ/δ, and the effect of this adjustment is to generate higher estimates of the utilisation rate. In particular, the estimates from model 4 across Tables 5 to 8 range from 0.34 to 0.40, and those from robust regression in Table 6 range from 0.29 to 0.43. This range in results is not unduly wide and suggests that the results are statistically robust. However, this conclusion presumes that model 4 is best and this is debatable. Starting with Model 1, as shown in equation (15) above, SFG present three alternatives:

(a) Model 2, which scales Model 1 by the dividend yield of the observation, and
(b) Model 3 which scales Model 1 by the inverse of the estimated standard deviation of the company's stock return, and
(c) Model 4 which scales Model 1 by both the dividend yield of the observation and the inverse of the estimated standard deviation of the company's stock return.

In support of the superiority of Model 2 over Model 1, SFG presents Figure 3, which shows an inverse relationship between dividend yield and the standard deviation of the regression residuals. In support of the superiority of Model 3 over Model 1, SFG presents Figure 4, which shows a positive relationship between stock return volatility and the standard deviation of the regression residuals. Model 4 is then presumably preferred because it contains both of these scaling variables that are judged by SFG to be desirable.

This line of reasoning has two shortcomings. Firstly, the tests reflected in Figure 3 and Figure 4, leading to SFG's preference for Model 4, are inadequate. The issue here concerns the possible presence of heteroscedasticity, and formal tests of this are available (Kennedy, 1996, section 8.3) but SFG have not used them. However, even if the analysis were limited to visual inspection of graphs as SFG have apparently done, the relevant graphs would be as follows:

(a) Plot the standard deviation of the Model 1 regression residuals for each group against the numerical *values* for the dividend yield for each group (rather than merely against

[9] Tables 5 to 8 differ in using or not using robust regression and the treatment of market-sensitive announcements.

the group number, as in Figure 3), and an inversely proportional relationship would support Model 2 over Model 1.[10]

(b) Plot the standard deviation of the Model 1 regression residuals for each group against the numerical *values* for the standard deviation of excess returns of each group (rather than merely against the group number, as in Figure 4), and a proportional relationship would support Model 3 over Model 1.

(c) Plot the standard deviation of the Model 1 regression residuals for each group against the numerical *values* for the product of the standard deviation of stock returns and the inverse dividend yield of each group, and a proportional relationship would support Model 4 over Model 1.[11]

Secondly, in scaling by the inverse of the estimated standard deviation of the company's stock price, there is exposure to errors in estimating the standard deviations and the effect of scaling by these erroneous estimates could be to produce an inferior rather than a superior estimate of the utilisation rate.[12] In the absence of suitable tests for the best model by SFG, and the exposure to errors in estimating the standard deviations of stock returns, it is not clear which of the four models is best. Accordingly, all of the estimates of the utilisation rate that can be derived from SFG's Tables 5 to 8 are potential candidates, and these estimates range from 0.16 to 0.59.[13] Even if adequate tests for the best model were performed, and they supported Model 4, Model 2 would still be a candidate because the standard deviations of stock returns could be estimated with error; the range of estimates for the utilisation rate would then be from 0.29 to 0.59. Even this is a very wide band and the upper limit of 0.59 is only trivially different from the estimate for the utilisation rate of 0.60 that is generally employed by Australian regulators.

[10] To simplify visual inspection, it would be even better to plot the standard deviation of the regression residuals against the inverse dividend yield, and a proportional relationship would then support Model 2 over Model 1.

[11] The plotting against values rather than group number arises from the fact that the underlying problem that SFG are concerned with is a relationship between the (level of the) variance of the residuals and (the level of) an independent variable.

[12] In Finance, the classic example of greater complexity yielding inferior results is Brown and Warner (1980), who find through a simulation exercise that attempting to estimate the market model parameters for the purpose of estimating excess returns yields inferior results to the simpler model in which the intercept is estimated at zero and the slope at 1.

[13] The estimate of 0.16 arises from model 1 with the OLS regression and outliers with $Z \geq 1$ removed, as shown in SFG's Table 7, with θ estimated at 0.13 and δ estimated at 0.80 (taken from their Table 5 as not provided in Table 7). The resulting estimate for the utilisation rate is then 0.13/0.80 = 0.16. In addition, the estimate of 0.59 arises from model 2 with the GLS regression and no outliers removed, as shown in SFG's Table 7, with θ estimated at 0.48 and δ estimated at 0.81 (taken from their Table 5 as not provided in Table 7). The resulting estimate for the utilisation rate is then 0.48/0.81 = 0.59.

In summary, SFG's tests for Models 2 and 3 against Model 1 are inadequate. Even if adequate tests were conducted, and Model 4 were favoured, Model 4 could still not be clearly judged to be superior to Model 2 because the standard deviations of stock returns used in Model 4 are subject to estimation error; the range of estimates for the utilisation rate would then be from 0.29 to 0.59. Even this is a very wide band and the upper limit of 0.59 is only trivially different from the estimate for the utilisation rate of 0.60 that is generally employed by Australian regulators.

2.7 Review of SFG: *Consistency of Conclusions with Statistical Findings*

SFG estimates the utilisation rate at 0.35, based upon their estimated values for θ from Model 4 and also from robust regression (which range from 0.27 to 0.38). However, this conclusion is not supported by their findings for the following reasons. Firstly, SFG mistakenly equate the utilisation rate with the parameter θ rather than θ /δ. Recognition of this point yields a range of estimated utilisation rates from 0.29 to 0.43, and a point estimate for the estimated utilisation rate of 0.40 based upon SFG's estimates for θ and δ of 0.35 and 0.875 respectively.

Secondly, SFG favour their Model 4 over other models. However their tests in support of this conclusion are inadequate, and Model 4 could not in any event be clearly judged to be superior to Model 2 because the standard deviations used in Model 4 are subject to estimation error. Until adequate tests are conducted, the admissible range of estimates for the utilisation rate is 0.16 to 0.59. Even if these tests favoured Model 4, Model 2 would still be a candidate for the reason mentioned above; the range of estimates for the utilisation rate would then be from 0.29 to 0.59.

In summary, SFG confuse the utilisation rate with one of their regression parameters and therefore underestimate the utilisation rate. In addition, SFG's preference for Model 4 over other models is based upon inadequate tests and, even if those tests favoured Model 4, they ought to have still given significant weight to the results from their Model 2, and doing so significantly widens the range of estimates for the utilisation rate, from 0.29 to 0.59. Consequently, SFG's estimate of 0.35 for the utilisation rate is not consistent with their findings.

2.8 Comparison of SFG with Previous Studies

As noted in section 2.3, properly interpreted, SFG's study generates an estimate for the utilisation rate from their Model 4 of about 0.40. By contrast, properly interpreted, the estimates from earlier studies are 0.72 for Beggs and Skeels (2006), 0.61 for Hathaway and Officer (2004), 1.10 for Bruckner et al (1994), and 0.52 for Brown and Clarke (1993). The principal differences between these papers lies in the time periods examined, the nature of the scaling, and the presence or absence of a constant in the regression.

The time periods examined in these studies are 1989-1991 for Brown and Clarke, 1990-1993 for Bruckner et al, 1986-2004 for Hathaway and Officer, 2000-2004 for Beggs and Skeels, and 2000-2010 for SFG. Given that there was a tax change in July 2000 that permitted Australian investors to fully utilise the tax credits, which is likely to have raised the utilisation rate, studies that estimate the utilisation rate from that point are preferred and studies with the longest data set since then are doubly preferred. On this basis, the SFG study is the best followed by that of Beggs and Skeels, and the difference in time periods alone *could* explain the difference in results between SFG and the earlier studies.

In respect of scaling the variables, the natural scaler in this area is price, because the volatility in price changes will grow with price, and all of the studies discussed above explicitly do so except that of Beegs and Skeels.[14] SFG go further in also scaling by the inverse of the estimated standard deviation of stock returns, and by resort to "robust regression" which reduces the weights on more volatile observations. The effect of scaling by the inverse of the estimated standard deviation of stock returns is quite significant, in that it reduces the estimated utilisation rate from 0.51 to 0.34, whilst the incremental effect of robust regression is much smaller, in that it only raises the estimated utilisation rate from 0.34 to 0.40.[15] As noted in the previous section, scaling by the inverse of the estimated standard deviation of stock returns may lead to an inferior estimate of the utilisation rate because of errors in estimating the standard deviations.

[14] Beggs and Skeels (2006, pp. 242-243) adjust the weights on their observations using share price, gross dividend and company size. Thus they address the issue indirectly.

[15] The figure of 0.51 derives from the estimates of δ and θ of 0.81 and 0.41 respectively for Model 2 in SFG's Table 5, the figure of 0.34 derives from the estimates of δ and θ of 0.91 and 0.31 respectively for Model 4 in SFG's Table 5, and the figure of 0.40 derives from the estimates of δ and θ of 0.93 and 0.37 respectively for Model 4 in SFG's Table 6.

In respect of the presence or absence of a constant in the regression, as previously discussed, the case for its exclusion is neither presented by SFG nor clear cut, some earlier studies do yield a statistically significant constant, and its omission could exert a material effect upon the estimate of the utilisation rate. The constant is omitted by Hathaway and Officer (2004) and it is included by Brown and Walter (1993), Bruckner et al (1994), and Beggs and Skeels (2006).

In summary, there are three principal points of difference between SFG's study and earlier studies. Firstly, SFG's study uses data from July 2000 (the time of the last tax change that could affect the estimated utilisation rate) to 2010 whilst the most recent of the earlier studies uses data only up to 2004, and this alone could explain the difference in results across the studies. Secondly, in addition to presenting results using the traditional scalar of price, SFG also scales observations by the inverse of the estimated standard deviation of stock returns, and also invokes "robust regression" which reduces the weights on more volatile observations. The use of the estimated standard deviation of stock returns significantly lowers the estimate of the utilisation rate, and this estimate may be less reliable because of errors in estimating the standard deviations, whilst the impact of robust regression on the estimated utilisation rate is much less significant. Finally, unlike most earlier studies, SFG do not include a constant in their preferred regression model, the case for doing so is neither presented nor clear cut, some earlier studies do yield a statistically significant constant, and its omission could materially affect the estimate for the utilisation rate.

2.9 Overall Conclusion on SFG's Estimate

SFG's analysis is subject to a number of theoretical concerns, as detailed in section 2.3. Of these, the most significant are the omission of a constant from their regression model, the potential impact of tax arbitrageurs on their results, and the fact that many studies have identified various anomalies on or around dividend ex-day that cannot be attributed to any kind of tax explanation. SFG's analysis has also eliminated a potentially large set of valuable observations, without any explanation or sensitivity analysis, and the evidence from other studies suggests that the inclusion of these observations could materially alter SFG's results. In addition SFG's preference for Model 4 is not supported by the tests they have conducted and, even if more appropriate tests were conducted and still supported Model 4, the results from Model 2 would still warrant significant weight, leading to a wide range of estimates of the utilisation rate, ranging from 0.29 to 0.59.

In view of the omission of the constant, and the exclusion of a potentially large number of highly relevant observations without any explanation or sensitivity analysis, I do not think that SFG's study should be relied upon in any way to form a view about the utilisation rate. Furthermore, even if these concerns were addressed by checking for the effect of including the constant and either inclusion of the missing observations or the presentation of a convincing argument for their exclusion, the potential impact of tax arbitrageurs on the results, the anomalous behaviour of returns at and around dividend ex-days, and the wide range of plausible estimates of the utilisation rate resulting from this study should discourage reliance upon it.

If no better estimate of the utilisation rate were available, some reliance would have to be placed on SFG's study. However, much better estimates are available and these will be discussed in the following sections. In any event, if any reliance were placed upon SFG's study, the fact that it also reveals that unfranked dividends are taxed more heavily than capital gains and therefore contradicts the Officer version of the CAPM raises substantial concerns about using the results of SFG's study in conjunction with Officer's version of the CAPM.

3. Implications of Foreign Investors for the Utilisation Rate

The fact that dividend drop-off studies yield an estimate for the utilisation rate that is less than 1 may be due to the presence of foreign investors in the Australian equity market, who cannot use or fully use the credits; this exerts a downward effect on the estimate with a consequent increase in the revenue or price cap for regulated firms. However, 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.[16] Consequently the use of an estimate for U that is potentially significantly influenced by the presence of foreign investors is inconsistent with this model. One possible 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

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

same phenomenon. However, if any methodology partly recognises some phenomenon (such as the presence of foreign investors), it should generate a result that lies 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 solely in respect of imputation credits will 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.

To explore this issue, it is necessary to consider the implications for the cost of equity of complete integration and complete segmentation of national markets for risky assets. It will also be desirable to impound all of the effects of imputation within the cost of equity capital rather than partly within the cash flows; it will then be sufficient to examine only the cost of equity capital. I start with complete segmentation of national equity markets, and therefore require a version of the CAPM that is consistent with this. Consistent with the behaviour of Australian regulators I adopt 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:

$$\hat{k}_e = R_f + \phi\beta_e \tag{16}$$

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

$$k_e = R_f + \phi\beta_e - I_e U \tag{17}$$

where I_e is the expected ratio of imputation credits to equity value for the firm in question (see Appendix). Under complete segmentation of national markets for risky assets, all investors in Australian stocks would be Australians and all of them can now use the imputation credits; so, U would be 1.[17] Letting ϕ_S denote the market risk premium within the Officer model for Australia under complete segmentation of national markets for risky assets, the cost of equity under complete segmentation and inclusive of the effects of imputation credits, denoted k_e^S, would then be as follows:

$$k_e^S = R_f + \phi_S \beta_e - I_e \tag{18}$$

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:

$$k_e^I = R_f + \phi_w \beta_{ew} \tag{19}$$

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

[17] 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.

The methodology generally employed by Australian regulators does not conform to either of these extreme models. Instead, the Officer model is invoked with a utilisation rate of about 0.60 and an estimate of the market risk premium that does not necessarily reflect complete segmentation of national markets for risky assets. With incorporation of the effects of imputation into the cost of equity rather than the cash flows, this is equivalent to invoking equation (17) with $U = 0.60$, i.e.,

$$k_e = R_f + \phi\beta_e - I_e(.60) \qquad (20)$$

We now seek to compare the regulatory approach in equation (20) to the extreme cases shown in equations (18) and (19). The Australian risk free rate R_f is common to all three models, and therefore the choice of a value is not significant.[18] So, we set the value at .03, corresponding to the yield to maturity on ten year government bonds in recent months.[19] In respect of the market risk premium and the equity beta within equation (20), we invoke the values commonly used by Australian regulators, i.e., $\phi = .06$ and $\beta_e = 1$.[20] In respect of the ratio of imputation credits to equity value, as discussed in the Appendix, 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, this is about 0.36 (see Lally, 2006, p 318). In respect of the average cash dividend yield of Australian firms, this is currently about 0.05 (CEG, 2011, Figure 7). The product of these two numbers is 0.018. In respect of regulated firms, we consider a band of values of ± 50% around this, i.e., I consider estimates of I_e from .009 to .027.

18 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.

19 Data from the website of the Reserve Bank of Australia (www rba.gov.au).

20 The same equity beta appears in equation (18), 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.

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 σ_w^2, and the variance on the Australian market portfolio be denoted σ^2, the market risk premium for the Solnik CAPM under complete integration relative to that of the Officer model under complete segmentation would then be as follows:

$$\frac{\phi_w}{\phi_S} = \frac{Q\sigma_w^2}{Q\sigma^2} = \frac{\sigma_w^2}{\sigma^2} \tag{21}$$

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.[21] Using these estimates in conjunction with equation (21), the implied value for ϕ_w is then as follows:

$$\phi_w = \frac{0.147^2}{0.164^2}\phi_S = 0.80\phi_S \tag{22}$$

The parameter ϕ_S reflects complete segmentation of equity markets. By contrast, the parameter ϕ appearing in equation (20) reflects present conditions, which involves some

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

degree of market integration rather than complete segmentation. However, the degree of integration is still rather limited.[22] Furthermore, the QCA's estimate of .06 for the parameter ϕ clearly places considerable weight on historical averaging of Australian market returns (QCA, 2011, pp. 238-240), and most of this data reflects complete segmentation. In recognition of partial integration, suppose that ϕ lies midway between ϕ_S and ϕ_w. Furthermore, in recognition of the QCA's estimate for ϕ placing substantial weight upon historical averaging, suppose that the QCA's estimate of .06 lies midway between ϕ_S and the true value for ϕ. It follows that the QCA's estimate of .06 lies 25% of the way from ϕ_S to ϕ_w. In conjunction with equation (22), this implies that

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

It follows that $\phi_S = .063$ and $\phi_w = .051$. Since the estimate for the variance ratio of 0.80 shown in equation (22) may be wrong, a range of values from 0.70 to 0.90 will be considered, implying a range of values for ϕ_w from .045 to .055 (and associated values of ϕ_S from .065 to .062).

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.[23] These results suggest that the betas of Australian firms against the

[22] 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).

[23] 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.

world market portfolio are considerably less than against the Australian market portfolio. Given a generally employed value for β_e of 1, and the estimate of 0.75 described above, we therefore adopt an estimate for β_{ew} of 0.75. However, we will consider a range of values from .65 to .85.[24]

Using these estimates, we now consider the results from equations (18), (19) and (20). For example, consider the mid-point estimates of I_e = 0.018, ϕ_w = .051, ϕ_S = 0.063, and β_{ew} = 0.75. The results from (18), (19) and (20) are then as follows.

Complete segmentation: $k_e^S = .03 + .063(1) - .018 = .075$

Complete integration: $k_e^I = .03 + .051(.75) = .068$

Officer: $k_e = .03 + .06(1) - .018(.60) = .079$

The results from the first two of these equations reveal that the effect of shifting from a world of complete segmentation to one of complete integration is to lower the cost of equity from .075 to .068, because the effect of losing the value of imputation credits is outweighed by the reductions in both the market risk premium and the beta. However, the result of .079 from the last of these three equations, whose methodology corresponds to that generally employed by Australian regulators, lies outside the bounds provided in the first two equations because recognition of the impact of foreign investors is principally limited to a reduction in the utilisation rate from 1 to 0.60, and therefore an increase in the estimated cost of equity. The methodology underlying this equation is therefore deficient because it is infeasible for the cost of equity to lie outside the bounds of complete segmentation and complete integration.

Table 1 below shows the results from equations (18), (19) and (20) in that order, for a range of values for I_e, ϕ_w, ϕ_S and β_{ew}.[25] The table shows that, in only 4/27 cases (shown in bold), the cost of equity that is generated by the Officer model with a utilisation rate on imputation credits of 0.60 is *within* the range of values arising from either complete segmentation or complete integration of equity markets; otherwise, it is higher. These four exceptions occur for extreme parameter combinations in the table.

[24] 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 (22).

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

Table 1: The Cost of Equity Capital Under Three Models

Model	ϕ_w	ϕ_S	$\beta_{ew} = .65$			$\beta_{ew} = .75$			$\beta_{ew} = .85$		
			$I_e = .009$	.018	.027	$I_e = .009$	.018	.027	$I_e = .009$	.018	.027
Seg	.045	.065	**.086**	.077	.068	**.086**	.077	.068	**.086**	.077	.068
Int	.045	.065	**.059**	.059	.059	**.064**	.064	.064	**.068**	.068	.068
Off	.045	.065	**.085**	.079	.074	**.085**	.079	.074	**.085**	.079	.074
Seg	.051	.063	.084	.075	.066	.084	.075	.066	.084	.075	.066
Int	.051	.063	.063	.063	.063	.068	.068	.068	.073	.073	.073
Off	.051	.063	.085	.079	.074	.085	.079	.074	.085	.079	.074
Seg	.055	.062	.082	.073	.064	.082	.073	.064	.082	.073	**.064**
Int	.055	.062	.066	.066	.066	.071	.071	.071	.077	.077	**.077**
Off	.055	.062	.085	.079	.074	.085	.079	.074	.085	.079	**.074**

These estimates in Table 1 are all based on an estimate for U of 0.60 in equation (20). If this estimate for U is lowered then the proportion of cases lying within the bounds arising from either complete segmentation or complete integration of equity markets would decline. With an estimate for U of 0.35, as proposed by SFG, 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 outside the bounds 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 almost 70%, i.e., the cost of capital estimated from the Officer model would lie within the required range in almost 70% of cases, as shown in bold in Table 2 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.[26]

Table 2: The Cost of Equity Capital Under Three Models

Model	ϕ_w	ϕ_S	$\beta_{ew} = .65$ $I_e = .009$	.018	.027	$\beta_{ew} = .75$ $I_e = .009$	.018	.027	$\beta_{ew} = .85$ $I_e = .009$	.018	.027
Seg	.045	.065	**.086**	**.077**	**.068**	**.086**	**.077**	.068	**.086**	**.077**	.068
Int	.045	.065	**.059**	**.059**	**.059**	**.064**	**.064**	.064	**.068**	**.068**	.068
Off	.045	.065	**.081**	**.072**	**.063**	**.081**	**.072**	.063	**.081**	**.072**	.063
Seg	.051	.063	**.084**	**.075**	**.066**	**.084**	**.075**	.066	**.084**	.075	.066
Int	.051	.063	**.063**	**.063**	**.063**	**.068**	**.068**	.068	**.073**	.073	.073
Off	.051	.063	**.081**	**.072**	**.063**	**.081**	**.072**	.063	**.081**	.072	.063
Seg	.055	.062	**.082**	**.073**	.064	**.082**	**.073**	.064	**.082**	.073	.064
Int	.055	.062	**.066**	**.066**	.066	**.071**	**.071**	.071	**.077**	.077	.077
Off	.055	.062	**.081**	**.072**	.063	**.081**	**.072**	.063	**.081**	.072	.063

In summary, the use of the Officer model is inconsistent with an estimate of the utilisation rate on imputation credits of 0.60 because the Officer model assumes that national equity markets are segmented whilst an estimate of the utilisation rate on imputation credits of 0.60 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, the approach generally employed by Australian regulators fails this test in virtually every case examined, and is therefore deficient. Furthermore this problem would be even more pronounced if SFG's proposal to lower the utilisation rate to 0.35 were adopted. In effect, combining Officer's CAPM with a utilisation rate of 0.60 or 0.35 rather than 1 constitutes a form of cherry-picking parameter values and models so as to maximise

[26] If the Officer model in equation (20) used an estimate of the market risk premium that prevailed under market segmentation, equation (20) would coincide with equation (18) and all sources of conflict would then be eliminated.

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, the test described here would be satisfied in most cases.

4. Alternative Methods for Estimating the Utilisation Rate

Having critiqued SFG's estimate of the utilisation rate, I now consider the merits of alternative methods. The starting point in assessing various approaches is a definition of the utilisation rate. 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 investors where the weights involve each investor's investment in risky assets and their risk aversion. A fundamental question here is whether foreign investors in the Australian equity market should be ignored in assessing the value of U; if they are ignored then the utilisation rate is 1 because all local investors can fully utilise the credits and any averaging over these local investors must also yield 1.

Turning now to estimation methods, the first of these arises from the fact that the methodology used to estimate the cost of equity capital that is generally employed by Australian regulators involves the Officer version of the CAPM, which assumes complete segmentation of national markets for risky assets, coupled with estimates of some parameters that may at least partly reflect the presence of foreign investors. Given this hybrid approach, one could choose parameter estimates so that the estimated cost of equity (inclusive of the benefits of dividend imputation credits that are provided by the company to its shareholders) lies within the bounds arising from complete segmentation of national equity markets and complete integration. As shown in the previous section, the likelihood of this outcome is maximised by ignoring foreign investors in estimating the utilisation rate and therefore using an estimated rate of 1.

The second possibility arises by recognising foreign investors and assuming (reasonably) that the risk aversion of foreigners approximates that of locals. It follows from the definition of U that it would then be a value-weighted average over the utilisation rates of locals and foreigners. Assuming additionally that foreigners cannot benefit from the credits (except through tax arbitrage), then U would be the proportion of Australian shares held by

Australians and this is currently about 0.54 (ASX, 2011, page 2). 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.

The third possibility is to estimate the utilisation rate by 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 0.81 since the last relevant tax changes in July 2000. This estimate will reflect the presence of foreigners and therefore will be inconsistent with the use of a CAPM that assumes complete segmentation of risky asset markets. 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), the estimate of the utilisation rate using this approach would under-weight the impact of foreigners in the definition of the utilisation rate, and therefore overestimate the utilisation rate.

The fourth possibility is to estimate the utilisation rate using contemporaneous pairs of traded shares, one traded cum dividend and other traded ex dividend. Walker and Partington (1999) adopt this approach and, using data from 1995-1997, estimate the utilisation rate at 0.88 (ibid, page 293). Again, the resulting estimate might reflect the presence of foreigners and therefore would be inconsistent with the use of a CAPM that assumes complete segmentation of risky asset markets. Furthermore, even if recognition of foreigners were warranted, this approach may produce an estimate of the utilisation rate that reflects transactions by an unrepresentative subset of investors.

The fifth possibility is to estimate the utilisation rate using contemporaneous prices for shares and futures contracts over shares. Cannavan et al (2004) adopt this approach and, using data from 1994-2000, estimate the utilisation rate at 0.15 prior to the introduction of the 45 day rule in July 1997 and -0.06 afterwards (ibid, Table 3).[27] Again, the resulting estimate might reflect the presence of foreigners and therefore would be inconsistent with the use of a CAPM that assumes complete segmentation of risky asset markets. Furthermore, even if

[27] As with dividend drop-off studies, these coefficients on imputation credits must be divided by the coefficient on cash dividends (0.95), but the effect here is inconsequential.

recognition of foreigners were warranted, this approach may produce an estimate of the utilisation rate that reflects transactions by an unrepresentative subset of investors.

In respect of the last two approaches, the potential exposure to unrepresentative subsets of investors is perfectly illustrated by the difference in the estimates of *U*. Walker and Partington (1999) estimate *U* at 0.88 over the period January 1995 to March 1997 whilst Cannavan et al estimate *U* at 0.15 for the period May 1994 to July 1997 and -0.06 for the period July 1997 to December 1999. Thus, Cannavan et al implicitly estimate *U* at 0.15 over the period January 1995 to March 1997, whilst Walker and Partington estimate it at 0.88 over the same period. These estimates are so different that it is entirely likely that they are driven by different subsets of investors, or by some unknown anomaly or microstructure feature (as discussed on pp. 14-15), and this undermines the credibility of both estimates.

In respect of SFG's methodology applied to the same period, SFG use data only from 2000. However Beggs and Skeels (2006) use a very similar methodology to that of SFG, and they estimate the utilisation rate at 0.23 for the period July 1991 to July 1997 and 0.53 for the period July 1997 to July 1999 (ibid, Table 5).[28] Thus, over the period January 1995 to March 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 -0.02 to 0.53 across two different methods, each of which also uses market data. So, again, these estimates are so different that it is entirely likely that they are driven by different subsets of investors, or by some unknown anomaly or microstructure feature, and this undermines the credibility of all estimates. Furthermore, in the period prior to July 1997, 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. This reinforces the concern expressed earlier, that the estimated utilisation rate from any methodology that uses market prices reflects the actions of an unrepresentative subset of investors, and is therefore inconsistent with the definition of *U* as a weighted average across all investors.

[28] 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.

In summary, there are six possible approaches to estimating the utilisation rate. The first of these arises from the definition of the parameter coupled with ignoring foreigners, and 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 0.54 (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 0.81. The remaining three possibilities use market prices, from simultaneous cum and ex-dividend share prices, simultaneous share and futures prices, and share prices before and after ex-dividend day. Only the latter approach has been applied to post July 2000 data, by SFG, and yields an estimate of 0.29 to 0.59. However, in respect of the last three approaches, a comparison of the estimates using data before July 2000 reveals dramatic differences across methodologies, from 0.15 to 0.88 in one period and from -0.02 to 0.53 in another period.

In my view, the most important requirements in selecting a methodology are that the estimate be consistent with the definition of the utilisation rate and that the parameter estimate maximises the chance that the estimated cost of equity from the Officer model lies within the bounds arising from either complete segmentation or complete integration of equity markets. The first approach described in the previous paragraph satisfies both of these requirements and is therefore recommended. The second approach described in the previous paragraph satisfies the first of these requirements, and is therefore ranked second. The remaining approaches satisfy neither of these two requirements. However, all three approaches that use market prices produce dramatically different estimates, presumably because they are driven by different subsets of investors or are subject to some unknown anomaly or microstructure feature (as described on pp. 14-15). By contrast, the third approach (the proportion of credits redeemed with the tax authorities) is at least free of this problem. I therefore rank this approach third, and all three approaches that use market prices are ranked last.

5. Implications of the Ownership of Regulated Firms

This section provides a brief review of different perspectives on the choice of the utilisation rate for State government-owned firms.

State government-owned and privately-owned businesses are subject to different tax treatment, with the former making corporate tax equivalent payments to the State rather than the Federal government, not issuing imputation credits (because they have not made corporate tax payments to the Federal tax authorities), and whose owners (taxpayers) are exempt from personal tax on the dividends and capital gains from these businesses. These differences give rise to the question of whether the State government-owned businesses should be subject to the same estimate for the utilisation rate as the privately-owned businesses. Current Australian regulatory practice is to apply the same cost of capital parameters to both privately and State government-owned regulated businesses, and to use parameter values that are applicable to privately-owned businesses.

One possible approach to this issue is based upon the fact that State government-owned businesses do not issue imputation credits and the non-issue of imputation credits is equivalent to a utilisation rate of zero. Accordingly, it might be argued that the appropriate utilisation rate for these businesses is zero. The effect of doing so would be to give rise to a higher price cap for State government-owned businesses than privately-owned businesses. However this approach ignores other aspects of the tax position facing State government-owned businesses and is also inconsistent with the definition of the utilisation rate within the Officer model as uniform across all firms.

A second possible approach to this issue is based upon the fact that, despite not issuing imputation credits, State government-owned business and their shareholders pay only one layer of tax (an equivalent corporate tax paid to the State government with no additional tax paid by their shareholders) whereas privately-owned businesses pay corporate tax to the Federal government (some or all of which is nullified by the imputation system) and their shareholders also pay personal tax on dividends and capital gains. Since the purpose of imputation is to reduce two tax layers to one, and State government-owned businesses are subject to only one layer, then these businesses might be viewed like a privately-owned business for whom imputation has nullified the corporate tax layer, i.e., the utilisation and distribution rates are both 1. In so far as the utilisation rate estimated for privately-owned businesses was less than 1 (see section 4) the result would be a price cap for State government-owned businesses that was lower than that for privately-owned businesses. However, if the average personal tax rate exceeds the corporate rate, the one tax layer paid by State government-owned businesses would not be identical to the one layer paid by the shareholders of privately-owned businesses for whom imputation nullifies their corporate tax payments. In addition, within the context of the Officer model, the utilisation rate is by definition uniform across firms.

A third possible approach to this issue is to recognise that the tax situation facing State government-owned business does not correspond to that assumed in the Officer model (because the Officer model assumes that dividends generate imputation credits). Accordingly one should hypothesise a business whose tax position was equivalent to that of the State government-owned businesses in substance and also consistent with the Officer model, and then treat the State government-owned businesses in the same way as this hypothetical business. Such a hypothetical business would be making corporate tax payments to the Federal tax authorities and issuing imputation credits but its owners would be unable to utilise the credits (because they were tax exempt). The Officer model would deal with this business by, inter alia, assigning to it the utilisation rate that applied uniformly to all firms. The same process would then apply to the State government-owned businesses and therefore these businesses would be subject to the same utilisation rate as all other businesses. Accordingly, the price cap for these State government-owned businesses would be the same as the privately-owned ones.

In my view only the last of these three possible approaches is consistent with the use of the Officer model. However, there are other consequences from the choice of approach. In particular, any approach that yields different price caps for the two types of firms (the first and possibly also the second approach) will give rise to a lack of equity across the customers of both types of businesses. In addition, any approach that produces a lower price cap for the State government-owned businesses (possibly the second one) would raise demand for, and therefore the output of, these State government-owned businesses at the expense of the private sector (with the extent of the output effect depending upon the price elasticity of demand and the extent of direct competition by private-sector firms).[29] Finally, if State government-owned businesses are assigned a utilisation rate less than 1 when the true

[29] In the absence of direct competition from private-sector firms, which is common, lower output prices by State government-owned businesses may raise demand and therefore output depending upon the price elasticity of demand and such an expansion in demand and hence output will give rise to lower demand and hence output throughout the rest of the economy. In the presence of direct competition from private-sector firms, lower output prices by State government-owned businesses will additionally lead to those businesses acquiring market share from their direct competitors in the private sector.

utilisation rate is 1, and therefore the rate of return allowed by the regulator is set too high, there may be an incentive for them to overinvest.

In view of these complexities, the appropriate utilisation rate for State government-owned businesses is not clear and I therefore favour further analysis of this issue.

6. Conclusions

This paper has sought to address a number of issues raised by the QCA relevant to the estimation of the utilisation rate on imputation credits (*U*), and the conclusions are as follows.

I have a number of theoretical concerns about SFG's approach to estimating the utilisation rate. Firstly, SFG mistakenly equate the utilisation rate with the coefficient on franking credits in their regression model rather than with this coefficient divided by the coefficient on cash dividends and the effect of this point is that SFG's estimated utilisation rate of 0.35 should instead be about 0.40. Secondly, although the utilisation rate is a weighted average over all investors in the market, the dividend drop-off approach used by SFG will tend to reflect the tax position of tax arbitrageurs and these investors may be only a small proportion of the entire market. Thirdly, many dividend drop-off studies have identified various anomalies that cannot be attributed to any kind of tax explanation and this raises the possibility that SFG's results are 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. Fourthly, SFG do not include a constant in their regression model; the case for doing so is neither presented nor clear cut, some earlier studies yield a statistically significant constant, and its omission could materially alter the estimate for the utilisation rate. Fifthly, SFG's approach to estimating the utilisation rate for insertion into the Officer version of the CAPM also suggests that unfranked dividends are taxed more heavily than capital gains, this tax differential is inconsistent with the Officer model, and this raises significant concerns about using the results of SFG's study in conjunction with the Officer CAPM.

In relation to SFG's treatment of data, SFG's process for selecting observations involves deleting those 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.

In relation to the statistical robustness of SFG's results, SFG favour the results from their Model 4 and also those from robust regression, which reduces the weights on more volatile observations. This produces a relatively narrow band of estimates of the utilisation rate from 0.29 to 0.43. However, SFG's tests for the best model are inadequate, and Model 4 could not in any event be clearly judged to be superior to Model 2 because the standard deviations of stock returns used in Model 4 are subject to estimation error. In the absence of adequate tests for the best model, the admissible range of estimates for the utilisation rate is 0.16 to 0.59, and therefore SFG's results are not statistically robust. Even if these tests favoured Model 4, Model 2 would still be a candidate because the standard deviations of stock returns used in Model 4 are subject to estimation error; the range of estimates for the utilisation rate would then be from 0.29 to 0.59. Even this is a very wide band and the upper limit of 0.59 is only trivially different from the estimate for the utilisation rate of 0.60 that is generally employed by Australian regulators.

In respect of whether SFG's conclusion (that the utilisation rate on imputation credits is 0.35) is consistent with their statistical findings, SFG confuse the utilisation rate with one of their regression parameters and therefore underestimate the utilisation rate (by 0.05). In addition, SFG's preference for Model 4 over other models is based upon inadequate tests and, even if those tests favoured Model 4, they ought to have still given significant weight to the results from their Model 2, and doing so significantly widens the range of estimates for the utilisation rate, from 0.29 to 0.59. Consequently, SFG's estimate of 0.35 for the utilisation rate is not consistent with their findings.

In respect of differences between SFG's study and earlier studies, there are three principal points of difference. Firstly, SFG's study uses data from July 2000 (the time of the last tax legislation change that could affect the estimated utilisation rate) to 2010 whilst the most recent of the earlier studies uses data only up to 2004, and this alone could explain the difference in results across the studies. Secondly, in addition to presenting results using the traditional scalar of price, SFG also scales observations by the inverse of the estimated standard deviation of stock returns, and also invokes the "robust regression" method. The use of the estimated standard deviation significantly lowers the estimate of the utilisation rate, and this estimate may be less reliable because of errors in estimating the standard deviations, whilst the impact of robust regression on the estimated utilisation rate is much less significant. Finally, unlike most earlier studies, SFG do not include a constant in their regression models, the case for doing so is neither presented nor clear cut, some earlier studies yield a statistically significant constant, and its omission could materially alter the estimate for the utilisation rate.

My overall conclusion on SFG's study is that it is subject to a number of theoretical concerns, of which the most significant are the omission of a constant from their regression model, the potential impact of tax arbitrageurs on their results, and the fact that many studies have identified various anomalies on or around dividend ex-day that cannot be attributed to any kind of tax explanation. SFG's analysis has also eliminated a potentially large set of valuable observations, without any explanation or sensitivity analysis, and the evidence from other studies suggests that the inclusion of these observations could materially alter SFG's results. In addition SFG's preference for Model 4 is not supported by the tests they have conducted and, even if more appropriate tests were conducted and still supported Model 4, the results from Model 2 would still warrant significant weight, leading to a wide range of estimates of the utilisation rate, ranging from 0.29 to 0.59. The omission of the constant and the exclusion of a potentially large number of observations without any explanation or sensitivity analysis could be addressed. However, even if they were, the remaining problems are sufficiently severe that they should discourage reliance upon the study. In any event, if any reliance were placed upon SFG's study, the fact that it also suggests that unfranked dividends are taxed more highly than capital gains and therefore contradicts the Officer version of the CAPM raises significant concerns about using the results of SFG's study in conjunction with Officer's version of the CAPM.

In relation to a potential inconsistency between market-based estimates of the utilisation rate and the use of the Officer version of the CAPM, the inconsistency arises because the Officer model assumes that national equity markets are segmented whilst a market-based estimate of the utilisation rate reflects the presence of foreign investors. In the face of this inconsistency, a minimum requirement is that the cost of equity capital results from this approach (inclusive of the effective reduction in company taxes) 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, 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 of 0.60 rather than 1 constitutes a form of cherry-picking parameter values and models so as to maximise 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, the test described here would be satisfied in most cases.

In relation to the range of possible approaches to estimating the utilisation rate, there are six possibilities. The first of these arises from the definition of the parameter (as a weighted average over the utilisation rates of individual investors) coupled with ignoring foreigners, and 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 0.54 (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 0.81. The remaining three possibilities use market prices, from simultaneous cum and ex-dividend share prices, simultaneous share and futures prices, and share prices before and after ex-dividend day. Only the latter approach has been applied to post July 2000 data, by SFG, and yields an estimate of 0.29 to 0.59. However, in respect of the last three approaches, a comparison of the estimates using data before July 2000 reveals dramatic differences across methodologies, from 0.15 to 0.88 in one period and -0.02 to 0.53 in another period. In my view, the most important considerations in selecting a methodology are that the estimate be consistent with the definition of the utilisation rate and that the parameter estimate maximises the chance that the estimated cost of equity from the Officer model lies within the bounds arising from either complete segmentation or complete integration of equity markets. The first approach satisfies both of these requirements and is therefore recommended ($U = 1$). The second approach satisfies the first of these requirements, and is therefore ranked second ($U = 0.54$). The remaining approaches satisfy neither requirement. However, all three approaches that use market prices produce dramatically different estimates, presumably because they are driven by different subsets of investors or are subject to some unknown anomaly or microstructure feature. By contrast, the third approach (the proportion of credits redeemed with the tax authorities) is at least free of this problem. I therefore rank this approach third ($U = 0.81$), and all three approaches that use market prices are ranked last.

Finally, the tax positions facing State government-owned businesses and privately-owned businesses are significantly different and this gives rise to the question of whether to use the same utilisation rate for both types of businesses. One approach would be to assign a utilisation rate of zero to State government-owned businesses because they do not issue imputation credits and non-issue is equivalent to a utilisation rate of zero. However, this approach fails to consider the broader tax differences between the privately-owned and State government-owned firms and is also inconsistent with the definition of the utilisation rate within the Officer model as uniform across all firms. A second approach would be to assign a utilisation rate of 1 to the State government-owned businesses on the grounds that they face only one layer of tax and a utilisation rate of 1 is consistent with this. However such an approach assumes that the average personal tax rate matches the corporate rate and is also inconsistent with the definition of the utilisation rate within the Officer model as uniform across all firms. A third approach would be to hypothesise a business whose tax position is equivalent to that of the State government-owned businesses in substance and also consistent with the Officer model, and then treat the State government-owned businesses in the same way as this hypothetical business; this would lead to applying the same utilisation rate to both privately-owned and State government-owned businesses. In addition to these conceptual issues, any approach that yields different price caps for the two types of firms will give rise to a lack of equity across the customers of both types of businesses. Also, any approach that produces a lower price cap for the State government-owned businesses would raise demand for, and therefore the output of, these State government-owned businesses at the expense of the private sector (with the extent of the output effect depending upon the price elasticity of demand and the extent of direct competition by private-sector firms). Finally, if State government-owned businesses are assigned a utilisation rate less than 1 when the true utilisation rate is 1, and therefore the rate of return allowed by the regulator is set too high, there may be an incentive for them to overinvest. In view of these complexities, the appropriate utilisation rate for State government-owned businesses is not clear and I therefore favour further analysis of this issue.

APPENDIX

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

Consider a regulated unlevered business subject to a one year regulatory cycle.[30] Let S_0 denote the current regulatory book value of equity, S_1 the value in one year, Y_1 the expected cash flows over the first year to equity holders (net of all deductions except company taxes) that arises from the regulatory modelling, TAX_1 the expected company taxes over the first year arising from the regulatory modelling, d the assumed proportion of these company taxes that are converted into imputation credits, and IC_1 the imputation credits over the first year arising from the regulatory modelling. 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

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

[30] The assumptions of no leverage and a one year regulatory cycle are adopted merely to simplify the presentation, and do 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 (17).

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