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Capital gains tax and the capital asset pricing model

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Abstract

This paper develops a version of the Capital Asset Pricing Model that views dividend imputation as affecting company tax and assumes differential taxation of capital gains and ordinary income. These taxation issues aside, the model otherwise rests on the standard assumptions including full segmentation of national capital markets. It also treats dividend policy as exogenously determined. Estimates of the cost of equity based on this model are then compared with estimates based on the version of the CAPM typically applied in Australia, which differs only in assuming equality of the tax rates on capital gains and ordinary income. The differences between the estimates can be material. In particular, with a high dividend yield, allowance for differential taxation can result in an increase of two to three percentage points in the estimated cost of equity. The overall result obtained here carries over to a dividend equilibrium, in which firms choose a dividend policy that is optimal relative to the assumed tax structure.

Key words: Capital Asset Pricing Model; Personal taxes

JEL classification: G12, G31.

1. Introduction

Estimation of the cost of equity capital is an important element in a number of applications in financial economics, including valuation of equities and real investment projects, and setting fair rates of return for regulated utilities. Standard practice in its estimation in Anglo-American countries is to apply some version of the Capital Asset Pricing Model (CAPM). All versions of the CAPM are subject to significant estimation problems in respect of the market risk premium

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and beta. This paper addresses the theoretical issues and related estimation problems that arise in respect of personal taxation issues.

Brennan (1970) was the first paper to modify the assumption of personal tax neutrality made in the original form of the CAPM due to Sharpe (1964), Lintner (1965) and Mossin (1966) (the 'SLM CAPM'). Despite being addressed to the taxation environment of the US, in which capital gains and ordinary income are differentially taxed, Brennan's work does not appear to have affected practice in that market as survey evidence suggests use of either the SLM CAPM or models other than the CAPM. However, the dividend imputation tax systems introduced in the UK, Australia and New Zealand have been modelled in further academic papers based on Brennan's work, and these papers have influenced practice, at least in Australia and New Zealand.[1] The forms of the CAPM developed in these papers are either based on viewing dividend imputation as affecting personal taxation or affecting company taxation.

In the models based on the personal tax view, dividends are defined as simply the cash payments made to shareholders, and dividend imputation results in these dividends being taxed at the lower rate than the rate on ordinary income.[2] Some of these models also recognise that capital gains are taxed at a lower rate than ordinary income.[3]

In the models based on the company tax view, arising from van Horne *et al.* (1990) and Officer (1994), the effect of imputation is to reduce company taxes. Dividends are defined to include the attached imputation credits, and the tax rate on dividends is thus the same as on ordinary income, in particular, interest income. If, in addition, it is assumed that the tax rate on capital gains is the same as on ordinary income, then the SLM CAPM will hold for returns where dividends are defined to include the associated imputation credits. This approach has been widely adopted in Australia amongst both the academic and practitioner communities in finance and we therefore refer in this paper to the SLM CAPM applied in this way as the 'conventional' CAPM.[4] However, the

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[1] A dividend imputation tax system was adopted in the UK in 1973, in Australia in 1987, and New Zealand followed in 1988. The basic system now exists in a wide range of countries; Smith (1993) provides a comprehensive review of the range of imputation tax systems across countries.

[2] These models include Stapleton and Burke (1977), Ashton (1989, 1991), Cliffe and Marsden (1992), Lally (1992), Okunev and Tahir (1992), Monkhouse (1993), van Zijl (1993), Brailsford and Davis (1995), Dempsey (1996), and Brailsford and Heaney (1998). This literature is reviewed in Lally (2000a).

[3] In New Zealand, common practice has been to apply a form of the CAPM that assumes dividends are effectively tax free (due to imputation), that capital gains are tax free, and that ordinary income is taxed at 33 per cent (see, for example, The Treasury, 1997).

[4] Examples of textbooks that have adopted the 'conventional' CAPM are Bishop *et al.* (2000, Ch. 19) and Peirson *et al.* (1998, Ch. 15). The reports of the utility regulatory authorities in

assumption of equality of the tax rates on capital gains and ordinary income does not correspond well to the actual Australian tax code. Capital gains are subject to a lower rate of tax than applies to ordinary income and the tax on gains is deferred until realisation. Furthermore, the recent review of the Australian tax code favours capital gains even more strongly than before, through partial exemption of long-term gains. Motivated by the introduction of this new tax structure, in this paper we estimate the effect on the estimated cost of capital from the assumption of equal tax rates on capital gains and ordinary income.

In Section 2 we derive the 'conventional' form of the CAPM. In section 3 we derive a form of the CAPM that, like the 'conventional' CAPM, is based on viewing imputation as affecting company tax, but it does not assume equality of the tax rates on capital gains and ordinary income. This taxation issue aside, the model is otherwise based on the standard assumptions including complete segmentation of national capital markets. It also treats firms as having exogenously determined dividend policies. We refer to this general CAPM based on viewing imputation as affecting *c*ompany *t*ax, but with *d*ifferential *t*axation of capital gains and ordinary income, as the CTDT CAPM. Since the 'conventional' CAPM is also based on viewing imputation as affecting company tax, then in the special case where there is equality of the tax rates on capital gains and ordinary income[5], the CTDT CAPM reduces to the 'conventional' CAPM. Thus, comparison of the CTDT CAPM with the 'conventional' CAPM provides an analytical expression for the capital gains tax effect. In Section 4 we explore the magnitude of this tax effect under a variety of assumptions about the values of the relevant parameters determining the cost of capital. Our conclusion is that, although the capital gains tax effect is in most cases small, in the case of high dividend yield companies, a difference of almost three percentage points could result. Differences of this degree have potentially significant practical implications for project adoption and for the setting of output prices for regulated utilities. Accordingly, adoption of a CAPM that recognises both dividend imputation and differential taxation of capital gains and ordinary income would seem to be justified.[6] In section 5 we relax the assumption that dividend policy is exogenously determined, and consider the capital gains tax effect under dividend policy equilibrium. Section 6 provides a summary of the results of the paper.

Victoria and New South Wales show general acceptance of the model for utility rate setting not only by the authorities but also by the entities affected and by their financial advisors. Anecdotal evidence the authors are aware of and their own casual observation both support there being a similar degree of acceptance of the approach for applications in the private sector.

[5] Or more generally that the weighted average tax terms T_1 and T_2, in equation (5) below, are both zero.

[6] Although the analysis in this paper is based on the CTDT CAPM, practical applications could employ either the CTDT CAPM or, alternatively, one of the models referred to in footnote 2, which view imputation as affecting personal tax.

2. The conventional CAPM

Under the 'conventional' CAPM, in which imputation is viewed as affecting company taxation, the rate of return on a stock before personal tax is defined as the capital gain, the cash dividend, and the imputation credits (to the extent that they can be used by investors in aggregate). The pre-personal tax rate of return on the shares of company j, denoted by $\hat{R}_j$, is thus given by:[7]

$$\hat{R}_j = \frac{P_{j1} - P_{j0}}{P_{j0}} + \frac{D_j}{P_{j0}}\left(1 + U\frac{IC_j}{D_j}\right) \tag{1}$$

where
D_j = company j's cash dividend per share over the next period
P_{jt} = price of shares in company j at time t
IC_j = imputation credits attached to the cash dividend of company j
U = market wide utilisation rate for imputation credits, which ranges from 0 to 1

This model differs from the SLM CAPM only in its definition of returns. In particular, with dividends defined to include imputation credits, dividends are taxed equally with other forms of income. So, in equilibrium:

$$E(\hat{R}_j) = R_F + [E(\hat{R}_m) - R_F]\frac{Cov(\hat{R}_j, \hat{R}_m)}{Var(\hat{R}_m)}$$

where
R_F = risk free rate for the period
$\hat{R}_m$ = rate of return on the market, defined in the same way as $\hat{R}_j$

The traditional definition for the rate of return on asset j, R_j, which excludes imputation credits, is:

$$R_j = \frac{P_{j1} - P_{j0}}{P_{j0}} + \frac{D_j}{P_{j0}}$$

Thus

$$\hat{R}_j = R_j + U\frac{IC_j}{P_{j0}}$$

[7] In this formulation the term $U(IC_j)/P_{j0}$ is equivalent to Officer's term τ_j, defined as the value of the tax credits expressed as a proportion of the current value of the share (Officer, 1994, p. 9).

If we assume that the end of period imputation credits are non-stochastic then:

$$\frac{Cov(\hat{R}_j,\hat{R}_m)}{Var(\hat{R}_m)} = \frac{Cov(R_j,R_m)}{Var(R_m)} = \beta_j$$

and thus

$$E(\hat{R}_j) = R_F + [E(\hat{R}_m) - R_F]\frac{Cov(R_j,R_m)}{Var(R_m)} \tag{2}$$

which is the 'conventional' CAPM.

3. The CTDT CAPM

As with the 'conventional' CAPM, the CTDT CAPM views imputation as affecting company tax. Unlike the 'conventional' CAPM it recognises differential taxation of capital gains and ordinary income.

The derivation parallels that of Elton and Gruber (1984) in respect of Brennan's (1970) version of the CAPM. Our assumptions are those of the SLM CAPM except that pre-personal tax returns are defined to include imputation credits attached to cash dividends (to the extent that individual investors can use them) and investors may be subject to differential tax treatment of capital gains and ordinary income. In respect of the capital gains tax rate, this is assumed to be symmetric over both gains and losses. As with the 'conventional' CAPM, we assume that dividends involve cash payments equally across shareholders, and we therefore disregard share repurchases that are *de facto* dividends.[8] As with the SLM and the 'conventional' versions of the CAPM, the assumptions include that of a one period world, and hence the capital gains tax rate applies to one-period capital gains and losses. However, since this model is intended for application to successive future periods for the purpose of discounting multi-period dividends, the estimate of the capital gains tax rate applied to single period gains/losses is reduced to reflect the effect of the payment being deferred until realisation of the gain.[9] As with the SLM and the 'conventional' versions of the CAPM, the assumptions also include complete segmentation of national capital markets; it follows that the cost of capital in Australia is determined by Australian investors. This has implications for the estimation of the utilisation parameter, *U*.

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[8] Share repurchases that are *de facto* dividends involve cash disbursements to shareholders but they may not be distributed equally across shareholders. This introduces the complication that the cash dividend yield may then differ across shareholders. At the present time, such share repurchases are not significant relative to 'normal' dividends and it therefore seems reasonable to abstract from this issue. We are grateful to one of the anonymous referees for raising the issue.

[9] This approach to dealing with the deferral issue is common in the literature (see Lintner, 1962; Howard and Brown, 1992).

On the basis of after-tax returns in the single period world, an investor i in a segmented market chooses an 'efficient' portfolio by combining the risk free asset in that market with their 'tangency' portfolio K[10]. Then, from Roll (1977), it follows that with unrestricted short selling, the expected after tax return on asset j to investor i, denoted by $E(\hat{r}_{ji})$, is related to the beta of j against portfolio K, as follows:

$$E(\hat{r}_{ji}) = r_{Fi} + [E(\hat{r}_{Ki}) - r_{Fi}]\frac{Cov(\hat{r}_{ji}, \hat{r}_{Ki})}{Var(\hat{r}_{Ki})} \tag{3}$$

where $\hat{r}_{Ki}$ is investor i's after tax return on portfolio K and r_{Fi} is the investor's after-tax return on the risk free asset.

Defining T_{gi} as investor i's tax rate on capital gains, T_{pi} as the investor's tax rate on ordinary income, and U_i as the investor's utilisation rate for imputation credits, the after tax return on asset j for investor i is:

$$\begin{aligned}\hat{r}_{ji} &= \frac{P_{j1} - P_{j0}}{P_{j0}}(1 - T_{gi}) + \frac{D_j}{P_{j0}}\left(1 + U_i\frac{IC_j}{D_j}\right)(1 - T_{pi}) \\ &= \left[\frac{P_{j1} - P_{j0}}{P_{j0}} + \frac{D_j}{P_{j0}}\left(1 + U_i\frac{IC_j}{D_j}\right)\right](1 - T_{gi}) - \frac{D_j}{P_{j0}}\left(1 + U_i\frac{IC_j}{D_j}\right)(T_{pi} - T_{gi})\end{aligned}$$

The pre-personal tax rate of return on asset j to investor i, inclusive of imputation credits to the extent they can be used by that investor, is:[11]

$$\hat{R}_{ji} = \frac{P_{j1} - P_{j0}}{P_{j0}} + \frac{D_j}{P_{j0}}\left(1 + U_i\frac{IC_j}{D_j}\right)$$

Thus:

$$\hat{r}_{ji} = \hat{R}_{ji}(1 - T_{gi}) - \frac{D_j}{P_{j0}}\left(1 + U_i\frac{IC_j}{D_j}\right)(T_{pi} - T_{gi})$$

[10] This portfolio K varies across investors and therefore should be denoted as portfolio K_i. However we reserve the subscript i to indicate that the return on an asset or portfolio is net of personal tax for investor i. To avoid confusion we then denote this portfolio simply by K.

[11] This definition of the rate of return differs from the definition in equation (1), in recognising that the utilisation rate for imputation credits is specific to an investor. Thus there are three definitions of the pre-personal tax rate of return: the traditional definition, which excludes imputation credits, the 'conventional' definition in equation (1) and the definition just introduced for the CTDT CAPM.

and similarly:

$$\hat{r}_{Ki} = \hat{R}_{Ki}(1 - T_{gi}) - \frac{D_K}{P_{K0}}\left(1 + U_i\frac{IC_K}{D_K}\right)(T_{pi} - T_{gi})$$

Also

$$r_{Fi} = R_F(1 - T_{pi})$$

As in the Brennan (1970) model, we assume that the end of period dividend is non-stochastic and similarly its associated imputation credits.[12] With this assumption, and substituting the last three equations into (3), the result is:

$$\begin{aligned} E(\hat{R}_{ji}) - R_F\left(\frac{1 - T_{pi}}{1 - T_{gi}}\right) &= \frac{E(\hat{r}_{Ki}) - r_{Fi}}{Var(\hat{r}_{Ki})}(1 - T_{gi})Cov(\hat{R}_{ji}, \hat{R}_{Ki}) \\ &\quad + \frac{D_j}{P_{j0}}\left(\frac{T_{pi} - T_{gi}}{1 - T_{gi}}\right)\left(1 + U_i\frac{IC_j}{D_j}\right) \\ &= \lambda_i Cov(\hat{R}_{ji}, \hat{R}_{Ki}) + \frac{D_j}{P_{j0}}\left(\frac{T_{pi} - T_{gi}}{1 - T_{gi}}\right)\left(1 + U_i\frac{IC_j}{D_j}\right) \qquad (4) \end{aligned}$$

where

$$\lambda_i = \frac{E(\hat{r}_{Ki}) - r_{Fi}}{Var(\hat{r}_{Ki})}(1 - T_{gi})$$

As stated previously, the traditional definition for the rate of return on asset j, which excludes imputation credits, is:

$$R_j = \frac{P_{j1} - P_{j0}}{P_{j0}} + \frac{D_j}{P_{j0}}$$

[12] This assumption is unsatisfactory in a multi-period context because the end of period price is uncertain and therefore so too are subsequent dividends. Thus the first dividend is assumed to be certain whilst subsequent ones are recognised to be uncertain. However Lally (1999) shows that, if all dividends are instead assumed to be stochastic, the only material effect is to replace the first period's dividend by its expectation in the resulting model. Whether a single period CAPM can be applied in a multi-period situation is another issue. Fama (1977) discusses conditions in which this can be done.

It follows that

$$\hat{R}_{ji} = R_j + U_i \frac{IC_j}{P_{j0}}$$

Therefore

$$E(\hat{R}_{ji}) = E(R_j) + U_i \frac{IC_j}{P_{j0}}$$

and

$$Cov(\hat{R}_{ji},\hat{R}_{Ki}) = Cov(R_j,R_K)$$

Substitution of the last two results into (4) gives:

$$E(R_j) + U_i \frac{IC_j}{P_{j0}} - R_F\left(\frac{1-T_{pi}}{1-T_{gi}}\right) = \lambda_i Cov(R_j,R_K) + \frac{D_j}{P_{j0}}\left(\frac{T_{pi}-T_{gi}}{1-T_{gi}}\right)\left(1 + U_i\frac{IC_j}{D_j}\right)$$

Defining w_i as the fraction of aggregate risky assets held by investor i, then multiplying the last equation through by w_i, dividing by λ_i, summing across all investors, and noting that $\Sigma w_i R_K = R_m$, gives:

$$E(R_j)\sum \frac{w_i}{\lambda_i} + \frac{IC_j}{P_{j0}}\sum \frac{w_i}{\lambda_i}U_i - R_F\sum \frac{w_i}{\lambda_i}\left(\frac{1-T_{pi}}{1-T_{gi}}\right) =$$
$$Cov(R_j,R_m) + \frac{D_j}{P_{j0}}\sum \frac{w_i}{\lambda_i}\left(\frac{T_{pi}-T_{gi}}{1-T_{gi}}\right) + \frac{D_j}{P_{j0}}\frac{IC_j}{D_j}\sum \frac{w_i}{\lambda_i}U_i\left(\frac{T_{pi}-T_{gi}}{1-T_{gi}}\right)$$

Dividing through by $\sum \frac{w_i}{\lambda_i}$ yields:

$$E(R_j) + \frac{IC_j}{P_{j0}}U - R_F(1-T_1) = \frac{Cov(R_j,R_m)}{\sum \frac{w_i}{\lambda_i}} = d_j T_1 + d_j \frac{IC_j}{D_j} U T_2 \tag{5}$$

where

$$U = \Sigma x_i U_i$$

$$T_1 = \sum x_i \left(\frac{T_{pi}-T_{gi}}{1-T_{gi}}\right) \tag{6}$$

$$x_i = \frac{w_i}{\lambda_i} \div \sum \frac{w_i}{\lambda_i} = \frac{w_i}{\left(\frac{E(\hat{r}_{Ki}) - r_{Fi}}{Var(\hat{r}_{Ki})}\right)(1 - T_{gi})} \div \sum \frac{w_i}{\left(\frac{E(\hat{r}_{Ki}) - r_{Fi}}{Var(\hat{r}_{Ki})}\right)(1 - T_{gi})} \quad (7)$$

$$d_j = \frac{D_j}{P_{j0}}$$

$$T_2 = \sum y_i \left(\frac{T_{pi} - T_{gi}}{1 - T_{gi}}\right)$$

$$y_i = \frac{w_i}{\lambda_i} U_i \div \sum \frac{w_i}{\lambda_i} U_i$$

Recalling the 'conventional' definition of return, $\hat{R}_j$, in equation (1), equation (5) then becomes:

$$E(\hat{R}_j) - R_F(1 - T_1) = \frac{Cov(R_j, R_m)}{\sum \frac{w_i}{\lambda_i}} + d_j T_1 + d_j \frac{IC_j}{D_j} U T_2 \quad (8)$$

Since this condition holds for all risky securities, it must also hold for the market portfolio, that is:

$$E(\hat{R}_m) - R_F(1 - T_1) = \frac{Var(R_m)}{\sum \frac{w_i}{\lambda_i}} + d_m T_1 + d_m \frac{IC_m}{D_m} U T_2$$

Solving for $\Sigma(w_i/\lambda_i)$, and substituting into (8), gives the CTDT CAPM:

$$E(\hat{R}_j) = R_F(1 - T_1) + d_j T_1 + d_j U \frac{IC_j}{D_j} T_2 + \left[E(\hat{R}_m) - R_F(1 - T_1) - d_m T_1 - d_m U \frac{IC_m}{D_m} T_2\right]\beta_j$$

that is[13]

$$E(\hat{R}_j) = R_F + [E(\hat{R}_m) - R_F]\beta_j + \Delta_j \quad (9)$$

[13] In the absence of imputation, this equation reduces to the CAPM derived by Brennan (1970).

where

$$\Delta_j = T_1[-R_F(1-\beta_j) + (d_j - d_m\beta_j)] + T_2\left(d_j U\frac{IC_j}{D_j} - d_m U\frac{IC_m}{D_m}\beta_j\right) \qquad (10)$$

Comparison of the CTDT CAPM stated in (9) with the ‘conventional’ CAPM in equation (2) shows that the difference is given by Δ_j.

From equation (10) it is readily seen that (in general) $\Delta_j = 0$ if

(1) $T_1 = T_2 = 0$, that is, that capital gains and ordinary income are taxed equally, on average. A sufficient condition is that $T_{gi} = T_{pi}$ for all i,

or (2) $\beta_j = 1$, $d_j = d_m$ and $IC_j/D_j = IC_m/D_m$, that is, the stock matches the market in respect of each of beta, dividend yield, and imputation credits relative to dividends.

As already noted earlier, capital gains and ordinary income are not taxed equally under the Australian tax system and therefore condition (1) does not hold. Condition (2) must hold (in a loose way) ‘on average’ and therefore the ‘conventional’ CAPM will on average correspond closely to the CTDT CAPM developed here with differential taxation of capital gains and ordinary income. However, for any given security, the difference between the two models could be significant.

4. Difference between the models

We now examine the difference between estimates of the cost of equity based on the two models, by substituting into the formula for Δ_j a plausible value or range of values for each of the parameters determining Δ_j.

4.1. Parameter values

The relevant parameters are the risk free rate, beta, dividend yield, the ratio of imputation credits to cash dividends, the utilisation rate for imputation credits, and the tax parameters.

Consistent with recent experience, at the time of writing we assume that the risk free rate is 0.06. In respect of beta, a plausible cross-sectional range is 0.5 to 1.5. The Australian market dividend yield is currently about 0.032 (data courtesy of JP Morgan) and the cross-sectional range is 0 to about 0.08. The market ratio of imputation credits to cash dividends is 0.22 (data courtesy of JP Morgan). At the firm level this can range from 0 to a maximum of 0.43 (based on the current corporate tax rate of 30 per cent).

The utilisation rate, *U*, is commonly estimated at 0.6, which is based on studies of ex-dividend returns and is consistent with the fact that foreign investors are significant in the market but cannot use the credits.[14] However, both the CTDT CAPM and the 'conventional' CAPM assume that national share markets are fully segmented. Consequently the utilisation rate should be 1 other than for the market weight of Australian investors unable to use the credits.[15,16] The only investors of this type are tax-exempt, and Wood (1997, footnote 10) estimates that their market weight is just 3–4 per cent. Thus it would appear reasonable to assume that U is 1.0.[17]

The final parameters requiring estimation are T_1 and T_2. The terms are each weighted averages across investors of the same tax ratio, but the weights differ, i.e., T_1 uses weights x_i and T_2 uses weights y_i. In so far as some investors cannot fully utilise imputation credits, the two sets of weights will differ and hence T_1 will differ from T_2. However, given our assumption above that $U = 1$, it follows that $T_1 = T_2$ (= T). Thus, for the present purposes:

$$\Delta_j = T\left\{d_j\left(1 + U\frac{IC_j}{D_j}\right) - R_F + \beta_j\left[R_F - d_m\left(1 + U\frac{IC_m}{D_m}\right)\right]\right\}$$

where

$$T = \sum x_i\left(\frac{T_{pi} - T_{gi}}{1 - T_{gi}}\right)$$

Estimation of T requires specification of the relevant investor set, estimation of their tax rates on both ordinary income and capital gains, and estimation of the weights, x_i. The holders of Australian equities can be broadly classified as foreigners, companies, superannuation funds and individuals. Since national capital markets are assumed to be segregated, it would be inconsistent to

[14] The rate is estimated at 0.80 by Brown and Clarke (1993), at 0.68 by Bruckner *et al.* (1994), at 0.44 by Hathaway and Officer (1995), and at 0.88 by Walker and Partington (1999).

[15] Even for investors on low incomes, the full benefit of the credits is available through a rebate of income tax.

[16] If, by contrast, markets were fully integrated then an international version of the CAPM would apply. This would affect not only the usability of imputation credits but also involve an international market risk premium and betas defined against the world market portfolio. The reduction in usability of the credits should raise the cost of equity but the other two effects should have a downward effect and the overall effect should be a reduction in the cost of equity (see Lally, 2000a, p. 40). Thus, if foreign investors are recognised in assessing the usability of imputation credits, but not otherwise, the effect is to raise the cost of equity, i.e., push it in a direction inconsistent with the total effect of internationalization. This argues for ignoring foreign investors in assessing the usability of imputation credits.

[17] However, in the sensitivity analysis below, we also show the impact of using instead the more common estimate of 0.6.

recognise foreign investors. Accordingly, we omit them from consideration. In respect of corporate holdings of shares in other companies, inclusion of them would lead to double counting. Consequently, we also omit them. If companies were subject to taxation on the dividends received from other companies the personal tax rates faced by the ultimate recipients (individuals and superannuation funds) would need to be increased to reflect this. However, companies are not taxed on dividend income, and therefore this potential complication is absent. Thus, having excluded both foreign investors and corporate shareholders, only individuals and superannuation funds need to be considered. In the interests of simplifying the estimation of T we assume that all individuals are taxed equally and all superannuation funds are taxed equally.

Under the current tax system, the highest marginal tax on ordinary income for individuals is 0.47 but many individuals will actually pay lower rates because of the progressive scale or because of income splitting. We treat individuals as a homogeneous group who are all subject to a 0.35 tax rate on ordinary income. In contrast, we assume that superannuation funds will face the applicable statutory tax rate of 0.15 on ordinary income.

Turning to capital gains, in Australia there are three factors that suggest that taxes on capital gains will be considerably less than on ordinary income, for both individuals and superannuation funds. Firstly, it is probable that most assets are held for more than one year, and hence most capital gains will be taxed at the concessionary 'long-term' rates. This is true despite an average turnover rate for Australian stocks in recent years of around 50 per cent (ASX Fact Book, 2001), because of wide variation across investors in holding periods.[18] To illustrate this point, suppose 10 per cent of stock is traded four times a year and the rest is traded every 10 years; the turnover rate is then 50 per cent but 90 per cent of stocks are subject to long-term capital gains tax. Secondly, in respect of these long-term gains, individuals are subject to tax on only 50 per cent of the assessable gains, and superannuation funds on only 67 per cent of them. Under the old tax system, only the real gain was subject to tax. Finally, capital gains are taxed only on realisation and the resulting opportunity to defer the tax effectively reduces the rate of the tax. Protopapadakis (1983) estimates that the opportunity to defer reduces the effective tax rate on capital gains by about 50 per cent.[19] Collectively these features of both investor behaviour and

[18] Froot *et al.* (1992, Table 1) report variations across investor classes in the US ranging from 1 to 7 years, the latter for passive pension funds. The variation across individual investors will be even more pronounced.

[19] The result reflects the US tax regime in a period in which long-term capital gains (greater than one year) were subject to concessionary treatment similar to the current situation in Australia. Thus, *prima facie*, the result is suggestive about the Australian situation. It should also be noted that the opportunity to defer lowers the effective tax rate not only because of the time value of money but also, as Hamson and Ziegler (1990, p. 49) note, because gains can be realised when the investor's tax rate is lower, such as in retirement.

the Australian taxation regime for capital gains suggest that, on average, individual investors and superannuation funds will pay capital gains tax at only 25 per cent and 33 per cent respectively of the rates applicable to ordinary income.[20] Applied to the above estimates for tax rates on ordinary income, this implies effective capital gains tax rates of 0.0875 and 0.05 respectively. That exemptions and/or the deferral option result in lower taxation on capital gains than on ordinary income is well recognised, not only for Australia (see Howard and Brown, 1992) but also for other countries such as the US (see Constantinides, 1984) and the UK (see Ashton, 1991).

In respect of the weights applied to the tax ratio in equation (7), the weight for investor i is:

$$x_i = \frac{w_i}{\left[\dfrac{E(\hat{r}_{Ki}) - r_{Fi}}{Var(\hat{r}_{Ki})}\right](1 - T_{gi})} \div \sum \frac{w_i}{\left[\dfrac{E(\hat{r}_{Ki}) - r_{Fi}}{Var(\hat{r}_{Ki})}\right](1 - T_{gi})}$$

The denominator term [ ] reflects the risk aversion of investor i, and is unknown. Given the absence of information about cross-sectional variation in risk aversion, we assume that the ratio is uniform across each of the two investor tax categories. The weight for investor type i then reduces to:

$$x_i = \frac{w_i}{(1 - T_{gi})} \div \sum \frac{w_i}{(1 - T_{gi})}$$

For individuals and superannuation funds the market investment weights, w_i, are 23 per cent and 11 per cent respectively.[21] These are rescaled to 68 per cent and 32 per cent respectively. Substituting for these values and the capital gains tax rates estimated above yields values for x_i of 0.68 for individuals and 0.32 for superannuation funds. Substitution into equation (5) produces an estimate for the tax parameter T of 0.23.

An alternative approach to estimating the value of T is to examine the results from dividend ex-day studies.[22] Based on Australian data for the period 1986–1995, Hathaway and Officer (1995, Table 2) report an intercept of 0.70 to 0.84

[20] The 25 per cent figure for individuals reflects all gains being taxed at the long-term rate, with a 50 per cent exemption and a further 50 per cent reduction to reflect the deferral effect. The 33 per cent figure for institutions is calculated in a similar manner.

[21] These weights derive from the ASX Fact Book, 2001. We treat all individual investors as homogeneous and all superannuation funds as homogeneous in their tax circumstances. We are grateful to David McCallum of ABN AMRO for advice on estimation of the average tax rates.

[22] We are grateful to John Redmayne of PricewaterhouseCoopers for suggesting this approach to estimating T.

in regressions of $\Delta P/D$ (share price change over the ex-dividend day divided by the cash dividend) on the imputation credits attached to the dividend. The results are consistent with the earlier work by Brown and Walter (1986), covering the period 1974–1985. The intercept in such regressions can be interpreted as being the mean value of $\Delta P/D$ in the absence of imputation credits. In the absence of imputation credits ΔP should be such that its post-tax value should equal the post-tax value of the cash dividend, that is,

$$\Delta P(1 - T_{ga}) = D(1 - T_{pa})$$

where T_{ga} is the average tax rate on capital gains and T_{pa} is the average rate on ordinary income. Thus

$$\frac{\Delta P}{D} = \frac{(1 - T_{pa})}{(1 - T_{ga})} = 1 - \frac{(T_{pa} - T_{ga})}{(1 - T_{ga})} \equiv 1 - T_a$$

The intercept values of 0.70 to 0.84 thus suggest an estimate for T_a in the range 0.16 to 0.30. In general T_a is not equal to T, because of variation in the capital gains tax rates across investors. However, in this case, there is little such variation and therefore T_a should be close to T. The research into ex-day returns thus indicates that T lies in the range of 0.16 to 0.30. This approach to estimating T_a does give rise to a number of concerns, including statistical uncertainty in the estimate of the intercept and various alternative explanations for intercept values differing from 1. The latter include microstructure explanations (Frank and Jagannathan, 1998), evidence of anomalous behaviour in the broader period around the ex-day (Brown and Walter, 1986) and the possibility that the value reflects the actions (and transactions costs) of arbitrageurs in a particular tax bracket buying just before and selling just after the ex-day. In view of these concerns, in the sensitivity analysis we adopt the estimate for T of 0.23 derived above but, in recognition of the uncertainty surrounding that estimate, we consider a range of possible values from 0.13 to 0.33.

4.2. Sensitivity analysis

Adopting the estimates $T = 0.23$, $R_F = 0.06$, $U = 1.0$, $d_m = 0.032$, and $IC_m/D_m = 0.22$, the sensitivity of Δ_j to variations in d_j, IC_j/D_j, and β_j is examined by varying one of the latter three parameters over its relevant range and holding the other two at their boundary values. Thus varying d_j over the interval [0, 0.08] results in Δ_j varying as follows:

over [–0.011, 0.007] for $IC_j/D_j = 0$ and $\beta_j = 0.5$
over [–0.007, 0.012] for $IC_j/D_j = 0$ and $\beta_j = 1.5$
over [–0.011, 0.015] for $IC_j/D_j = 0.43$ and $\beta_j = 0.5$, and
over [–0.007, 0.020] for $IC_j/D_j = 0.43$ and $\beta_j = 1.5$

Similarly, varying IC_j/D_j over the interval [0, 0.43] results in Δ_j varying as follows:

over [−0.011, −0.011] for $d_j = 0$ and $\beta_j = 0.5$
over [−0.007, −0.007] for $d_j = 0$ and $\beta_j = 1.5$
over [0.007, 0.015] for $d_j = 0.08$ and $\beta_j = 0.5$, and
over [0.012, 0.020] for $d_j = 0.08$ and $\beta_j = 1.5$

Finally, varying β_j over the interval [0.5, 1.5] results in Δ_j varying as follows:

over [−0.011, −0.007] for $d_j = 0$ and $IC_j/D_j = 0$
over [−0.011, −0.007] for $d_j = 0$ and $IC_j/D_j = 0.43$
over [0.007, 0.012] for $d_j = 0.08$ and $IC_j/D_j = 0$, and
over [0.015, 0.020] for $d_j = 0.08$ and $IC_j/D_j = 0.43$

These results are summarised in column five of Table 1. The sensitivity of Δ_j to variation in U is examined by repeating the above calculations with $U = 0.6$ instead of 1.0. The results are shown in column seven of Table 1.

Finally, we consider T. As T is proportional to Δ_j, if T increases by 43 per cent from 0.23 to 0.33, the absolute value of Δ_j also increases by 43 per cent. Similarly, if T is reduced to 0.13, the absolute value of Δ_j declines by 43 per cent. This is evident from comparison of the fourth, fifth and sixth columns of Table 1.

The conclusions from this sensitivity analysis are as follows. First, across the range of values considered for the parameters, Δ_j varies dramatically: with

Table 1
Differences in estimates of the cost of equity under different CAPMs

			Δ_j				θ_j		$\Delta_j + \theta_j$
d_j	IC_j/D_j	β_j	$T = 0.13$ $U = 1$	$T = 0.23$ $U = 1$	$T = 0.33$ $U = 1$	$T = 0.23$ $U = 0.6$	$T = 0.23$ $U = 1$	$T = 0.23$ $U = 0.6$	$T = 0.23$ $U = 1$
0	0	0.5	−0.006	−0.011	−0.016	−0.011	0.004	0.002	−0.008
0	0	1.5	−0.004	−0.007	−0.009	−0.006	0.011	0.006	0.004
0	0.43	0.5	−0.006	−0.011	−0.016	−0.011	0.004	0.002	−0.008
0	0.43	1.5	−0.004	−0.007	−0.009	−0.006	0.011	0.006	0.004
0.08	0	0.5	0.004	0.007	0.010	0.007	0.004	0.002	0.011
0.08	0	1.5	0.007	0.012	0.017	0.013	0.011	0.006	0.022
0.08	0.43	0.5	0.008	0.015	0.021	0.012	−0.031	−0.019	−0.016
0.08	0.43	1.5	0.011	0.020	0.028	0.018	−0.024	−0.014	−0.004

This table shows values for Δ_j, θ_j and their sum for various combinations of the firm specific parameters d_j, IC_j/Dj and β_j, and the market-wide parameters T and U. All calculations assume $R_F = 0.06$, $d_m = 0.032$ and $IC_m/D_m = 0.22$.

T = .23 and U = 1, the variation is from –0.011 to 0.020; with T = 0.33, the variation increases proportionately from –0.016 to 0.028. Second, variation in each of β_j, IC_j/D_j and U does not, in general, result in a significant effect on the value of Δ_j. Third, variation in d_j is significant for any combination of values of the other parameters.

The key influences on Δ_j are thus d_j and T. For companies with a high dividend yield, use of the 'conventional' CAPM rather than the CTDT CAPM developed here results in a lower estimate of the cost of equity capital. Conversely, for low dividend yields, the cost of equity capital estimated under the 'conventional' CAPM will be higher. As T increases, this effect is magnified. The most significant difference occurs with large values for both d_j and T, where the 'conventional' CAPM would generate a cost of equity capital that is lower by as much as 2.8 percentage points.

One response to the analysis presented above might be to argue that the true value of T is highly uncertain and that the bounds on the value of Δ are modest. Consequently a departure from the 'conventional' CAPM in favour of the CTDT CAPM presented here is not justified. However, the 'conventional' CAPM essentially represents a first step modification to the SLM CAPM, in that it incorporates dividend imputation but not differential taxation of capital gains and ordinary income. We therefore compare the 'conventional' CAPM to the SLM CAPM. The SLM CAPM states that

$$E(R_j) = R_F + [E(R_m) - R_F]\beta_j \tag{11}$$

where the returns R_j and R_m are defined in the traditional way. From section 2, $\hat{R}_j$ and R_j are related as follows:

$$\hat{R}_j = R_j + Ud_j\frac{IC_j}{D_j}$$

Thus

$$E(\hat{R}_j) = E(R_j) + Ud_j\frac{IC_j}{D_j} \tag{12}$$

and similarly

$$E(\hat{R}_m) = E(R_m) + Ud_m\frac{IC_m}{D_m} \tag{13}$$

Solving for $E(R_j)$ and $E(R_m)$, and substitution into (11), generates the following expression for the SLM CAPM:

$$E(\hat{R}_j) = R_F + [E(\hat{R}_m) - R_F]\beta_j - Ud_m\frac{IC_m}{D_m}\beta_j + Ud_j\frac{IC_j}{D_j}$$

that is

$$E(\hat{R}_j) = R_F + [E(\hat{R}_m) - R_F]\beta_j - \theta_j \tag{14}$$

where[23]

$$\theta_j = U\left(\beta_j d_m \frac{IC_m}{D_m} - d_j \frac{IC_j}{D_j}\right) \tag{15}$$

Comparison of (14) with the 'conventional' CAPM in equation (2) shows that the cost of equity calculated by use of the 'conventional' CAPM differs from that calculated from the SLM CAPM by the addition of θ_j. It immediately follows from (9) that the cost of equity calculated from the CTDT CAPM differs from that calculated from the SLM CAPM by the addition of $(\theta_j + \Delta_j)$. The 'conventional' CAPM is then a first step in closing the gap through the addition of θ_j.

Table 1 shows the values of Δ_j, θ_j and $(\theta_j + \Delta_j)$. Two significant conclusions are apparent from a comparison of Δ_j, θ_j, and $(\theta_j + \Delta_j)$, based on values for U and T of 1 and 0.23 respectively. First, across the eight cases considered in the rows of Table 1, the average absolute values for Δ_j and θ_j are comparable, at 1.1 per cent and 1.3 per cent respectively.[24] Thus, looked at in isolation, θ_j (the adjustment to the SLM CAPM introduced by the 'conventional' CAPM) and Δ_j (the adjustment to the 'conventional' CAPM, as proposed in this paper) are of comparable importance. Second, across the eight cases considered in Table 1, the values for $(\theta_j + \Delta_j)$ are invariably smaller in absolute terms than those for Δ_j.[25] Relative to the cost of equity as given by the CTDT CAPM in equation (9), which recognises both imputation and differential taxation of capital gains and ordinary income, the sum $(\theta_j + \Delta_j)$ is the 'error' from use of the SLM version of the CAPM, which recognises neither of these tax phenomena. Relative to the same benchmark, the quantity Δ_j is the 'error' from using the 'conventional' CAPM, which does not recognise differential taxation of capital gains and ordinary income. Thus, across the eight cases considered in Table 1, the use of the 'conventional' CAPM typically induces a *greater* 'error' than use of the SLM

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[23] The left hand side of equation (11) is an expectation over return defined in the traditional way. Equation (14) restates (11) so that it involves an expectation over returns defined in the 'conventional' way, permitting ready comparison of the SLM CAPM in (14) with the 'conventional' CAPM.

[24] If $U = 0.6$, the figures become 1.1 per cent and 0.8 per cent respectively.

[25] This is because Δ_j is typically opposite in sign to θ_j. Examination of the formulas for Δ_j and θ_j in equations (10) and (15) respectively provides the explanation. The term Δ_j is a positive function of d_j and IC_j/D_j, and a negative function of d_m and IC_m/D_m. For θ_j the reverse holds.

CAPM. A dramatic example appears in the last row of Table 1: with $T = 0.23$ and $U = 1$, the SLM CAPM overstates the cost of equity by only 0.4 percentage points ($\theta_j + \Delta_j$) whereas the 'conventional' CAPM understates it by 2.0 percentage points (Δ_j).

This analysis suggests that, if dividend imputation is to be recognised, it is at least as important to additionally recognise differential taxation of capital gains and ordinary income. The CAPM applied could take the form of the CTDT CAPM derived in this paper, in which imputation is viewed as affecting company taxation, or, alternatively, a model in which imputation is viewed as affecting personal taxation.

4.3. Consequences

The consequences of the differences identified in the preceding section are twofold. First, since the cost of equity is a component of the weighted average cost of capital, which is used to calculate the present value of the cash flows from prospective projects, the choice of CAPM could lead to the incorrect rejection and/or acceptance of some projects.[26] Undoubtedly the adoption decision for many projects will not be sensitive to variations in the cost of equity to the degree shown here. Nevertheless, the decision for at least some projects will be affected. For projects with very long lives, variations of even two percentage points to the discount rate can have a substantial effect upon present value, and therefore on the adoption decision.

The second consequence is for utility companies whose output prices are set on the basis of estimated cost of capital, such as those involved in electricity, gas or airports. The recent price determination for electricity companies issued by the regulator for Victoria (Office of the Regulator-General, Victoria, 2000) provides a relevant example. The parameter values adopted were $R_F = 0.062$, $U = 0.60$, and β_j was set equal to 1.00 for all companies. Among the companies subject to the regulations, one company had an average cash dividend yield over the last 3 years of 0.083, and a ratio of imputation credits to cash dividends of zero. Thus, using the additional market parameter estimates discussed above, of $T = 0.23$, $d_m = 0.032$ and $IC_m/D_m = 0.22$, the resulting value of Δ for the company is 0.011. That is, in this case, the 'conventional' CAPM estimate is lower than that of the CTDT CAPM estimate by 1.1 percentage points. If $T = 0.33$, this difference increases to 1.5 percentage points. The revenue implications of this would be very substantial for the company.[27] Furthermore, this is

[26] With an average equity:debt ratio of 76:24 for Australian companies (Independent Pricing and Regulatory Tribunal, 1998, Appendix 1), any 'error' in estimating the cost of equity capital will have a significant effect upon the WACC.

[27] Had the cost of equity been estimated by the SLM CAPM, the corresponding differences would have been 1.5 and 2.0 percentage points. In this case, use of the 'conventional' CAPM produces a smaller 'error' than the SLM CAPM, but only by 0.4 percentage points.

not a pathological case as high dividend yields are common amongst utility companies.

5. Optimal dividend policy

The derivation of the CTDT CAPM is based *inter alia* on the assumption that dividend policy is exogenous. However, if the CTDT CAPM is the appropriate version of the CAPM, then firms' dividend policies should be consistent with it. Of course dividend policies reflect many factors other than just tax issues and it is impossible to quantify their effects. Nevertheless, in this section, we investigate choice of dividend policy in the tax world reflected in the CTDT CAPM, assuming that taxes are the only factor relevant to choice of dividend policy.[28]

The CTDT CAPM treats imputation as a company tax phenomenon, and therefore its effect is to reduce the effective company tax rate. This means that imputation is reflected in the cash flows while differential taxation of capital gains and ordinary income is reflected in the cost of equity. Dividend policy is most simply analysed if both effects are contained in the cost of equity. Thus it is necessary to develop a form of the CAPM that is based on viewing imputation as affecting *p*ersonal *t*axation and that also allows for *d*ifferential *t*axation of capital gains and ordinary income – the PTDT CAPM. This version of the CAPM is based on the traditional definition of return. So the relationships in equations (12) and (13) are substituted into the CTDT CAPM in equation (9). With $U = 1$ and $T_1 = T_2 = T$, the result is:[29]

$$E(R_j) = R_F + [E(R_m) - R_F]\beta_j - R_F T(1 - \beta_j) + d_j\left[T - (1 - T)\frac{IC_j}{D_j}\right] - d_m\beta_j\left[T - (1 - T)\frac{IC_m}{D_m}\right] \qquad (16)$$

A firm's dividend can be decomposed into the part that is fully franked and the part that is unfranked. So long as T is positive (ordinary income is more highly taxed than capital gains), which is clearly the case, it is not optimal for any firm to pay unfranked dividends. Consequently all dividends are fully franked and therefore:

$$\frac{IC_j}{D_j} = \frac{T_c}{1 - T_c}$$

[28] We are very grateful to Professor Bruce Grundy for the arguments that are presented in this section.

[29] This corresponds to the CAPM of Lally (1992, 2000b) under the same conditions of $U = 1$ and $T_1 = T_2 = T$.

Thus the PTDT CAPM in equation (16) reduces to:

$$E(R_j) = R_F + [E(R_m) - R_F]\beta_j - R_F T(1-\beta_j) + d_j\left[\frac{T - T_c}{1 - T_c}\right] - d_m\beta_j\left[\frac{T - T_c}{1 - T_c}\right]$$

The dividend policy of a firm involves the choice of d_j, and it can be seen that this affects the cost of equity $E(R_j)$ through the penultimate term on the right hand side of the last equation for the PTDT CAPM. This in turn affects the value of equity in an inverse fashion because all tax effects from dividend policy are captured in this last equation. Looking at the penultimate term, if T exceeds the corporate tax rate T_c, then firms can reduce their cost of capital by avoiding the payment of even franked dividends. In a ‘progressive’ tax regime, such as that of Australia, the effect would be to lower T. Similarly, if T were less than T_c, all firms would seek to raise the level of fully franked dividends; in so far as any increase was possible, this would raise T. These kinds of considerations suggest that an equilibrium in the market would involve $T = T_c$, no unfranked dividends and some equilibrium level of franked dividends in the market as a whole.[30] Thus, in a dividend equilibrium, the equation for the PTDT CAPM reduces to

$$E(R_j) = R_F(1 - T_c) + [E(R_m) - R_F(1 - T_c)]\beta_j \tag{17}$$

This shows that the level of franked dividends paid by any particular firm would not affect its cost of equity $E(R_j)$.[31] Equation (17) not only excludes the dividend yield of the firm but T equals the observable corporate tax rate. Consequently the recognition of differential personal taxation of capital gains and ordinary income introduces no estimation problems. If equation (17) is applied to a firm with $\beta_j = 0$ then it reduces to $E(R_j) = R_F(1 - T_c)$. Since dividend policy

[30] This equilibrium argument used here resembles that proposed by Miller (1977), in examining optimal capital structure. However the result here is not assured. For example, if T exceeds T_c at the current level of dividends, the complete elimination of all dividends by all firms may not be sufficient to reduce T down to the level of T_c. Similarly, if T is less than T_c at the current level of dividends, an increase in dividends to the point where no further fully franked dividends can be paid by any firm may not be sufficient to raise T to the level of T_c.

[31] It is also worth noting that, if dividend policy is irrelevant in tax terms and imputation credits are fully utilizable by all investors, then the choice of debt versus equity is also irrelevant in tax terms. To see this, suppose a firm was fully debt funded. Its pre-tax cash flows of X would then be paid out as interest. The after-tax cash flow to investor i would then be $X(1 - T_{pi})$. By contrast, if it was fully equity funded, we could act as if the X was fully paid as dividends. With $U = 1$, corporate tax would be completely displaced by personal tax and investor i would receive an after-tax cash flow of $X(1 - T_{pi})$. Thus the after-tax cash flow received by any investor would be invariant to capital structure.

is irrelevant so long as dividends are fully franked, suppose the $E(R_j)$ is all in the form of cash dividends. The after personal tax return to investor i is then:

$$\begin{aligned} D - TAX &= D - [T_{pi}(Gross\ D) - IC] \\ &= R_F(1 - T_c) - \left[T_{pi}\frac{R_F(1 - T_c)}{1 - T_c} - R_F(1 - T_c)\frac{T_c}{1 - T_c}\right] \\ &= R_F(1 - T_{pi}) \end{aligned}$$

which equals the after personal tax return from the risk free asset. This is to be expected for a zero beta stock.

We now repeat the sensitivity analysis undertaken in section 4.2, and presented in Table 1, except for the special circumstances here in which $U = 1$, $T = T_c = 0.3$ and

$$\frac{IC_j}{D_j} = \frac{T_c}{1 - T_c} = .43$$

The results are presented in Table 2. The results are similar to those obtained in the previous section. First, the difference between the cost of equity under the CTDT CAPM and under the 'conventional' CAPM (Δ_j) is up to 2.3 per cent. Second, across the four cases considered in the rows of Table 2, the average absolute values for Δ_j and θ_j are comparable, at 1.7 per cent each. Thus, looked at in isolation, θ_j (the adjustment to the SLM CAPM introduced by the 'conventional' CAPM) and Δ_j (the adjustment to the 'conventional' CAPM in the CTDT CAPM) are of comparable importance. Third, across the four cases considered in Table 2, the values for $(\theta_j + \Delta_j)$ are always smaller in absolute terms than those for Δ_j. Relative to the cost of equity given by the CTDT CAPM, which recognises both imputation and differential taxation of capital gains/interest, the sum $(\theta_j + \Delta_j)$ is the 'error' from use of the SLM version of the CAPM, which recognises neither of these tax issues. Relative to the same

Table 2
Differences in estimates of the cost of equity under different CAPMs in a dividend equilibrium

d_j	β_j	Δ_j	θ_j	$\Delta_j + \theta_j$
0	0.5	−0.016	0.007	−0.009
0	1.5	−0.012	0.021	0.009
0.08	0.5	0.018	−0.028	−0.009
0.08	1.5	0.023	−0.014	0.009

This table shows values for Δ_j, θ_j and their sum, in the presence of 'optimal' dividend policy, for various combinations of the firm specific parameters d_j and β_j. All calculations assume $R_F = 0.06$, $d_m = 0.032$, U = 1, $T_c = 0.30$ and $IC_j/D_j = IC_m/D_m = 0.43$.

benchmark, the quantity Δ_j is the 'error' from using the 'conventional' CAPM, which does not recognise differential taxation of capital gains and ordinary income. Thus, across the four cases considered in Table 2, the use of the 'conventional' CAPM always induces a *greater* 'error' than use of the SLM CAPM. A dramatic example appears in the last row of Table 2: relative to the CTDT CAPM proposed here, the SLM CAPM understates the cost of equity by 0.9 percentage points ($\theta_j + \Delta_j$) whereas the 'conventional' CAPM understates it by 2.3 percentage points (Δ_j).

5. Conclusion

This paper has developed the CTDT Capital Asset Pricing Model, which views dividend imputation as affecting company tax and recognises differential taxation of capital gains and ordinary income. These taxation issues aside, the model otherwise rests on the standard assumptions including full segmentation of national capital markets. It also treats dividend policy as exogenous. Estimates of the cost of equity based on the CTDT CAPM are compared with estimates from the 'conventional' CAPM. The difference resulting from use of the 'conventional' CAPM is on average zero and sensitivity analysis shows that in many circumstances the difference is quite small. However, where the dividend yield is very high, the difference could be two to three percentage points. Furthermore, relative to the CTDT CAPM model proposed in this paper, the 'error' in estimating the cost of equity from use of the 'conventional' model is typically larger than from use of the SLM model. Thus use of the 'conventional' model appears to be unsatisfactory.

This overall result was also found to apply in a dividend equilibrium, based on choice of dividend policy that is optimal relative to the assumed tax structure.

References

Ashton, D., 1989, Textbook formulae and UK taxation: Modigliani and Miller revisited, *Accounting and Business Research* 19, 207–212.

Ashton, D., 1991, Corporate financial policy: American analytics and UK taxation, *Journal of Business Finance and Accounting* 31, 465–482.

Bishop, S., H. Crapp, R. Faff, and G. Twite, 2000, *Corporate finance*, 4th edition (Prentice-Hall).

Brailsford, T. and K. Davis, 1995, Valuation with imputation, *JASSA*, March, 14–18.

Brailsford, T. and R. Heaney, 1998, *Investments: concepts and applications in Australia* (Harcourt Brace & Co).

Brennan, M., 1970, Taxes, market valuation and corporate financial policy, *National Tax Journal* 23, 417–27.

Brown, P. and T. Walter, 1986, Ex-dividend day behaviour of Australian share prices, *Australian Journal of Management* 11, 139–152.

Brown, P. and A. Clarke, 1993, The Ex-dvidend day behaviour of Australian share prices before and after dividend imputation, *Australian Journal of Management* 18, 1–40.

Bruckner, K., N. Dews, and D. White, 1994, Capturing value from dividend imputation, *McKinsey and Company*.

Cliffe, C. and A. Marsden, 1992, The effect of dividend imputation on company financing decisions and the cost of capital in New Zealand, *Pacific Accounting Review* 4, 1–30.

Constantinides, G., 1984, Optimal stock trading with personal taxes: implications for prices and the abnormal January returns, *Journal of Financial Economics* 13, 65–89.

Dempsey, M., 1996, The cost of equity capital at the corporate and investor levels allowing a rational expectations model with personal taxation, *Journal of Business Finance and Accounting* 23, 1319–31.

Elton, E. and M. Gruber, 1984, Non-standard C.A.P.M.s and the market portfolio, *Journal of Finance* 39, 911–924.

Fama, E., 1977, Risk-adjusted discount rates and capital budgeting under uncertainty, *Journal of Financial Economics* 5, 3–24.

Frank, M. and R. Jagannathan, 1998, Why do stock's prices drop by less than the value of the dividend, *Journal of Financial Economics* 47, 161–188.

Froot, K., A. Perold and J. Stein, 1992, Shareholder trading practices and corporate investment horizons, *Journal of Applied Corporate Finance* 5(2), 42–58.

Hamson, D. and P. Ziegler, 1990, The impact of dividend imputation on firms' financial decisions, *Accounting and Finance* 30, 29–53.

Howard, P. and R. Brown, 1992, Dividend policy and capital structure under the imputation tax system: some clarifying comments, *Accounting and Finance* 32, 51–61.

Hathaway, N. and R. Officer, 1995, The value of imputation tax credits, Working paper (University of Melbourne, Melbourne).

Independent Pricing and Regulatory Tribunal, 1998, *The rate of return for electricity distribution networks*, discussion paper.

Lally, M., 1992, The CAPM under dividend imputation, *Pacific Accounting Review* 4, 31–44.

Lally, M., 1999, The CAPM under personal taxation and stochastic dividends, Working paper (Victoria University of Wellington, Wellington).

Lally, M., 2000a, *The cost of equity capital and its estimation*, McGraw-Hill Series in Advanced Finance, vol. 3 (McGraw-Hill Australia).

Lally, M., 2000b, Valuation of companies and projects under differential personal taxation, *Pacific-Basin Finance Journal* 8, 115–133.

Lintner, J., 1962, Dividends, earnings, leverage, stock prices and the supply of capital to corporations, *Review of Economics and Statistics* 44, 243–70.

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

Miller, M., 1977, Debt and taxes, *The Journal of Finance* 32, 261–275.

Monkhouse, P., 1993, The cost of equity under the Australian dividend imputation tax system, *Accounting and Finance* 33, 1–18.

Mossin, J., 1966, Equilibrium in a capital asset market, *Econometrica* 24, 768–83.

Officer, R., 1994, The cost of capital of a company under an imputation tax system, *Accounting and Finance* 34, 1–17.

Office of the Regulator-General, Victoria, 2000, *Electricity distribution price determination 2001–2005*.

Okunev, J. and M. Tahir, 1992, The effect of the imputation tax system upon the capital asset pricing model, Working paper (Australian National University, Canberra).

Peirson, R., R. Brown, S. Easton, and P. Howard, 1998, *Business finance*, 7th edition (McGraw-Hill Australia).

Protopapadakis, A., 1983, Some indirect evidence on effective capital gains taxes, *Journal of Business* 56, 127–38.

Roll, R., 1977, A critique of the asset pricing theory's tests: Part I, *Journal of Financial Economics* 4, 129–176.

Smith, A., 1993, Comprehensive dividend imputation, neutrality and double taxation of corporate profits, *The Bulletin for International Fiscal Documentation* 47, 568–80.

Sharpe, W., 1964, Capital asset prices: a theory of market equilibrium under conditions of risk, *Journal of Finance* 19, 425–42.
Stapleton, R. and C. Burke, 1977, European tax systems and the neutrality of corporate financial policy, *Journal of Banking and Finance* 1, 55–70.
The Treasury, 1997, *Estimating the cost of capital for crown entities and state-owned enterprises*, The Treasury, Wellington.
van Horne, J., K. Davis, R. Nicol, and K. Wright, 1990, *Financial management and policy in Australia*, 3rd edition, Prentice-Hall Australia.
van Zijl, T., 1993, The effects of leverage and dividend policy on cost of capital under differential taxation, Working paper (Victoria University of Wellington, Wellington).
Walker, S. and G. Partington, 1999, The value of dividends: evidence from cum-dividend trading in the ex-dividend period, *Accounting and Finance* 39, 275–96.
Wood, J., 1997, A simple model for pricing imputation tax credits under Australia's dividend imputation tax system, *Pacific-Basin Finance Journal* 5, 465–80.