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The valuation of projects under the dividend imputation tax system

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Abstract

This paper proves that a modified weighted average cost of capital ("WACC") valuation methodology is a rigorous and practicable method of valuing projects and companies under the Australian dividend imputation tax system. This methodology uses an effective tax rate in calculating both the discount rate and the ungeared after tax cash flow. A cash flow after effective corporate tax is shown to be equivalent to a cash plus value of imputation credit stream. Importantly, this valuation methodology is applicable to returns that are non-uniform and of finite duration. Also examined is the discounting of equity returns at the company's cost of equity capital. A worked example is presented to clarify and quantify the effects discussed.

Key words: Valuation; Dividend imputation tax system

JEL classification: G31

1. Introduction

The valuation of projects and companies by discounted cash flow analysis is a common and widely accepted valuation technique. The introduction of the dividend imputation tax system in 1987 means that dividends can now be fully franked and carry imputation credits to end investors, thereby providing Australian tax-paying investors greater after-tax income than an unfranked dividend of the same cash amount. However, the traditionally accepted valuation technique ignores the imputation credits associated with the dividend stream and essentially ascribes zero value to the imputation credits. This has the potential to significantly understate the

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value of companies and projects when they are valued by discounted cash flow techniques.[1]

The purpose of this paper is to provide a practicable and rigorous method of valuing Australian companies and projects. While a variety of discounted cash flow techniques can be used, this paper examines two distinct approaches: (i) discounting ungeared, or project, cash flows at the project's weighted average cost of capital ("WACC")—this is probably the most common approach and is sometimes referred to as the "textbook" approach;[2] and (ii) discounting equity cash flows at the company's cost of equity capital. In both cases, "cash" can be defined as either cash plus the value of imputation credits, or cash only. In total, therefore, four alternative valuation approaches are considered in this paper.

In evaluating the alternative valuation approaches to ensure that they are both practicable and rigorous the following points need to be considered. First, to be practicable the valuation approach should be able to be applied in a straightforward and non-iterative manner. Many of the approaches outlined above result in circular calculations which have to be solved iteratively. Second, to be rigorous the valuation approach should not make any assumptions that are inconsistent with the real world. Specifically, the valuation approach should be applicable to cash flows that are non-uniform and of finite duration. Many of the equations frequently cited in textbooks and elsewhere are only accurate for constant in-perpetuity cash flows—which is of limited practical use. Further, a rigorous valuation approach should explicitly consider investor-level taxes, especially as the effects of dividend imputation are only manifested at the investor level.

The twin issues of valuing projects with non-uniform cash flows of finite duration and explicit consideration of investor-level taxation have been considered in the literature in the case of the classical tax system. For example, the literature shows that in the classical tax system the textbook WACC can be applied to finite lived projects as long as care is taken to ensure an appropriate debt–equity ratio is used in the equations.[3] Similarly, the literature also shows that the textbook WACC is an accurate formulation regardless of the structure of investor-level taxes.[4]

There are two subtle effects here which require further explanation. First, the textbook WACC, for example, can be *derived* quite simply in either a classical or imputation tax system by assuming constant in-perpetuity cash flows. And the literature demonstrates that the textbook WACC can, in certain circumstances, be

[1]For a more detailed discussion on the effects of the dividend imputation system on the valuation of projects and companies by discounted cash flow techniques see P.H.L. Monkhouse (1993), pp. 2–5.

[2]See, for example, J.A. Miles and J.R. Ezzell (1980), pp. 719–720.

[3]See, for example: N.C. Strong and T.R. Appleyard (1992); R.A. Taggart (1991); J.A. Miles and J.R. Ezzell (1980); S. Bar-Yosef (1977); and C.M. Linke and M.K. Kim (1974).

[4]See, for example: R.A. Taggart Jr. (1991), especially footnote 12; and N.C. Strong and T.R. Appleyard (1992).

applied in a classical tax system to finite-lived projects with non-uniform cash flows. It does not necessarily follow, however, that equations derived in an imputation tax system, under the assumption of constant in-perpetuity cash flows, can be *applied* to finite lived projects with a varying level of cash flows. Second, and similar to the issue concerning constant in-perpetuity cash flows, the textbook WACC can be *derived* by ignoring investor-level taxes. And the literature demonstrates that the textbook WACC can be applied in the classical tax system regardless of the specification of investor-level taxes. However, the textbook WACC requires the cost of equity capital as an input—and the determination of this depends upon the structure of the investor-level taxes. Hence the *application* of the textbook WACC requires that some, perhaps implicit, assumption be made about investor-level taxes.

Officer has published extensively on the effect of the Australian dividend imputation tax system on a company's WACC.[5] However, Officer's analysis and equations have been derived in the context of constant, in-perpetuity cash flows. Officer appears to acknowledge, implicitly at least, the shortcomings of this approach as in a worked example he states "Assume that the profit and loss statement has been reconstituted to reflect the company's maintainable or sustainable income and this is consistent with definitions of cash flow".[6] Unfortunately he offers no guidance as to how any non-uniform cash flows associated with a project of a finite life are to be reconstituted into the equivalent constant in-perpetuity cash flows. In addition, Officer does not discuss the assumptions on investor-level taxation which underpin his analysis.

The contribution of this paper is that in the context of the Australian dividend imputation tax system it considers: (i) the valuation of projects with non-uniform cash flows of finite duration; (ii) the valuation of projects in a world of investor-level taxes; and (iii) the practicability of the alternative valuation approaches. Further, it is noted that the equations presented in this paper are based on a cost of equity capital applicable to the Australian dividend imputation tax system, and this has been rigorously derived. It is noted that the equations presented in this paper are not always the same as the equations derived by Officer (1994).

This paper also demonstrates that all of the valuation approaches considered result in identical values for a given project. It is worth noting that Taggart (1991) stated in the context of the classical tax system that achieving consistency in the various valuation approaches can prove elusive due to the variety of assumptions that must be made in formulating the valuation equations.[7]

The structure of this paper is as follows. Section 2 reviews the key results of my earlier paper[8] which considered, in a single-period framework, the effects of

[5]See R.R. Officer (1994); R.R. Officer (1990); R.R. Officer (1988); and R.R. Officer (1987).

[6]R.R. Officer (1994), p. 13.

[7]See also D.R. Chambers, R.S. Harris and J.J. Pringle (1982).

[8]P.H.L. Monkhouse (1993).

dividend imputation on the cost of equity capital. This forms the starting point of the analysis as dividend imputation affects the returns to equity holders only—the returns to debt holders are both readily observable and unlikely to have changed as a result of the introduction of dividend imputation. In discounting an equity cash flow, two definitions of "cash" are considered: cash only, and cash plus the value of imputation credits. This Section also discusses briefly the difficulties of applying the single-period equations presented.

Section 3 then derives two WACCs in the context of a single-period model: one is applicable to an ungeared cash flow only while the other is applicable to an ungeared cash plus value of imputation credit stream. The WACC applicable to cash flow only is shown to be equivalent to the classical textbook WACC. However, a key variable in calculating a numerical value for the WACC is the cost of equity capital. While this is given by my earlier paper, this valuation approach is shown to be impracticable. By contrast, the WACC applicable to cash plus the value of imputation credits is shown to be a practicable formulation.

Section 4 discusses the issues involved in extending the single-period equations to the far more practicable multi-period setting. In Section 5 the two single-period WACCs derived in Section 3 are extended to a multi-period setting. The WACC applicable to the ungeared cash flow only is shown to be dependent on the composition of the cash flows to equity holders and to result in a circular calculation. It is not, therefore, considered a practicable formulation. However, the WACC applicable to the ungeared cash plus value of imputation credit stream is shown to result in a practicable and rigorous valuation methodology.

Section 6 derives two cost of equity capital formulations in a multi-period setting. One formulation is applicable to an equity cash flow only while the other is applicable to an equity cash plus value of imputation credit stream.

The alternative valuation methodologies are reviewed in Section 7 and a recommended valuation approach is presented. This approach uses an effective tax rate in calculating both the WACC and the ungeared after tax cash flow. A cash flow after effective corporate tax is shown to be equivalent to a cash plus value of imputation credit stream. The approach is applicable to the Australian dividend imputation tax system and to returns that are non-uniform and of finite duration. A worked example which demonstrates the recommended approach is presented in Appendix 1. The consistency of this approach with the other valuation approaches is shown numerically in Appendix 2.

2. Discounting equity cash flows—A single period framework

Dividend imputation primarily affects returns to equity holders net of all taxes. Accordingly, any changes to discounted cash flow techniques resulting from the introduction of dividend imputation are likely to be driven by changes to the cash flows to equity holders and/or the cost of equity capital. Importantly, the cost of equity capital is typically estimated by the Capital Asset Pricing Model ("CAPM") which itself is a single-period model.

This Section reviews the key results of my earlier paper which considered the effects of dividend imputation on the cost of equity capital in a single-period framework. It also explicitly considered the effects of investor-level taxation. Accordingly, the valuation equations outlined in this Section reflect the existence of investor-level taxation, even though the cash flows being discounted are determined before any investor-level tax charges. That is, the effects of investor-level taxation can be considered to be reflected in the discount rate and not the cash flow.

Reviewing my earlier paper serves to introduce the notation and definitions used throughout the paper. Also introduced in this Section are some additional definitions which will be used later in the paper.

This Section examines two methods by which cash flows to equity holders can be discounted. The first method is as shown in my earlier paper and discounts a cash flow only while the second method results from an algebraic rearrangement of the first approach and discounts cash plus the value of imputation credits. The discounting of cash plus the value of imputation credits is shown to be equivalent to discounting a cash flow after effective corporate tax. The practicability of both these valuation approaches is discussed.

2.1. Assumptions

The assumptions used to derive a cost of equity capital under a dividend imputation tax system were outlined in my earlier paper. While these are not repeated here, one key assumption that was made was the equivalence of investor-level tax rates on capital gains and losses, gross dividend income (cash plus imputation credits) and interest income.

In addition, the following assumptions will be made in this paper and are stated here for completeness:

- the imputation credit payout ratio and utilisation factors are independent of leverage and are known in advance;
- for the sake of simplicity it will be assumed that the risk-free interest rate and the company's cost of debt are constant for all periods; and
- an active debt management policy will be followed by the company. This is discussed in more detail in Section 4.

2.2. Notation and definitions

In discussing discounted cash flow valuation techniques it is important to distinguish between tax payments at the corporate level and at the investor level. It is inherent in the dividend imputation tax system that some investors can claim a credit for the tax paid by the company, which means that at least part of the corporate tax payments can, in effect, represent a pre-payment of investor-level taxes.

To assist in the distinction between corporate tax payments and investor-level tax payments it is useful to define two types of cash flows: cash flows after corporate tax; and cash flows after *effective* corporate tax. Cash flows after corporate tax will refer to cash flows after the payment of corporate tax, and this payment will, in general, represent a payment of *effective* corporate tax *plus* a pre-payment of investor-level tax. Consequently, cash flows referred to as after *effective* corporate tax will be equal to cash flows after corporate tax *plus* the value of the pre-payment of investor-level tax.

Importantly, both types of cash flows (after corporate tax and after effective corporate tax) are calculated before the specific calculation of investor-level tax payments. That is, the cash flows referred to in this paper are *not* net of all tax charges. To this extent, both types of cash flows can be considered as before investor-level tax payments, even though the cash flow after corporate tax represents the possible pre-payment of some investor-level tax.

My earlier paper[9] modelled a cash flow to equity holders that was after corporate tax payments but before investor-level tax payments by; a cash flow before interest and tax, less tax paid after taking into account tax "savings" on deductions and interest paid, and less principal and interest payments. Mathematically, the cash flow available to equity holders after corporate tax and debt repayment is represented by: $E(\mathbf{X}) - [E(\mathbf{X}) - P - r_d L]T - L(1 + r_d)$, which equals:

$$E(\mathbf{X})(1 - T) + PT - [1 + r_d(1 - T)]L \tag{2.1}$$

where

$\mathbf{X}$[10] = the company's cash flow before interest and (Australian) tax;
P = the amount deducted from cash flows in calculating Australian taxable income because of factors such as depreciation, carried-forward tax losses and foreign tax payments, but does not include any tax deductibility for interest. It is essentially an adjustment to allow for the case where the actual Australian corporate tax rate on before (Australian) tax cash flows is not the nominal corporate tax rate, T;
r_d = company's cost of debt;[11]
L = principal outstanding at beginning of period; and
T = the nominal corporate tax rate, currently 36%.

My earlier paper assumed that a company could borrow at the risk-free rate of interest, although this paper does not make that assumption. Rather, it assumes that any borrowings are at the company's cost of debt.

[9]The notation is as used in my earlier paper except for the subscripts which have been dropped.

[10]The bold typeface indicates a random variable and the expected value is written as $E(\mathbf{X})$.

[11]As discussed in R.A. Taggart Jr. (1991) in footnote 5, the company's cost of debt must be interpreted as an expected, rather than promised, rate of return on the company's borrowings.

Reference to equation (7.2) of my earlier paper shows that the cost of equity capital applicable to this equity cash flow after corporate tax payments, before investor-level tax payments, is given by:

$$k_e^C = E(\mathbf{r}) = r_f + \beta^L[E(\mathbf{R_m}) - r_f] - \theta^d D' t_f - \theta^r RIC' \quad (2.2)$$

where

k_e^C = the cost of equity capital applicable to an after corporate tax cash flow. The superscript "C" indicates that the discount rate is consistent with a cash flow stream only, in contrast to a cash and imputation credit stream described below;

$E(\mathbf{r})$ = expected return on the company's equity, before investor-level tax payments, due to cash flow only;

r_f = risk-free rate of interest;

β^L = the beta of the levered company's equity, or the observed equity beta of the company;

$E(\mathbf{R_m})$ = the expected *total* return on the market, and includes the expected return due to after corporate tax cash flows *plus* the expected return due to the value of imputation credits. $E(\mathbf{R_m}) - r_f$ represents the equity risk premium;

θ^d = the utilisation factor of distributed imputation credits;

θ^r = the utilisation factor of retained imputation credits. That is, \$1 of retained imputation credits is assumed to result in a capital gain of $\$\theta^r$;

RIC = $[E(\mathbf{X}) - P - r_d L]T - Dt_f$, the amount of imputation credits retained by the company, which is equal to the Australian corporate tax paid less the imputation credits distributed via dividends;

D = $d/(1 - t_f)$, the grossed-up dividend paid by the company. It is also equal to the cash dividend (d) plus imputation credits distributed. The amount of imputation credits distributed can be determined algebraically as $D - d = Dt_f$;

t_f indicates the level of franking of a dividend. $t_f = 0$ under a "classical" tax system or if the dividends are unfranked and $t_f =$ current corporate tax rate (maximum) if the dividends are fully franked. Assuming an opening franking account balance of zero, t_f will equal zero if $(\mathbf{X} - P - r_d L)T \leq 0$ and the dividend will be fully franked if $d \leq (1 - T)(\mathbf{X} - P - r_d L)$. The value of t_f could, of course, be less than the current corporate tax rate, corresponding to the dividend being partially franked;

D' = D/S, the gross dividend yield of the company;

RIC' = RIC/S, the "yield" associated with amount of the retained imputation credits; and

S = the value of equity of the company.

As noted in my earlier paper, the modified CAPM consists of the classical CAPM with two additional terms. The term $\theta^d D' t_f$ is company specific and represents the value of the imputation credits distributed by the company, divided by the value of the company's equity. In effect, it is the rate of return (or yield) attributable to distributed imputation credits. Similarly, the term $\theta^r RIC'$ is also company specific and represents the rate of return attributable to retained imputation credits.

2.3. Additional definitions

Three definitions will be introduced which will be used shortly. First, an imputation credit payout ratio (α) shall be defined as the value of imputation credits obtained by shareholders divided by the amount of imputation credits generated in the period. Mathematically, this can be expressed as:[12]

$$\alpha = Dt_f / \{[E(\mathbf{X}) - P - r_d L]T\} \tag{2.3}$$

The imputation credit payout ratio can exceed unity if there is a non-zero opening franking account balance. To simplify the analysis, it will be assumed in this paper that α is independent of leverage. Note that α will be company specific.

Given $[E(\mathbf{X}) - P - r_d L]T - Dt_f = RIC$, equation (2.3) can be rewritten as:

$$RIC = (1 - \alpha)[E(\mathbf{X}) - P - r_d L]T \tag{2.4}$$

Note that by assuming a certain imputation credit payout ratio we are not making any specific assumptions about the company's dividend policy, rather we are assuming the level of dividends and the level of franking will be such as to ensure the imputation credit payout ratio is maintained.

Second, the company's effective tax rate (T_e) will be defined mathematically as:

$$T_e = \{1 - [\alpha\theta^d + (1 - \alpha)\theta^r]\}T \tag{2.5}$$

While this equation is a definition, it will be shown below that this definition is consistent with our notation of cash flows after *effective* corporate tax being equal to cash flows after tax plus the value of the pre-payment of investor-level tax.

As we have assumed α, θ^d and θ^r to be independent of leverage, known in advance, and company specific, T_e will also be independent of leverage, known in advance and company specific.

Third, the ratio of the amount of debt (L) to the value of the company (V), or gearing ratio, shall be defined as:

$$\ell = L/V \tag{2.6}$$

[12]The α in this paper has a different interpretation to that in my earlier paper.

If a gearing ratio is specified, the level of debt is determined by reference to the calculated value of the company. However in the context of a single-period framework, once the level of debt is determined, and the amount drawn-down at the beginning of the period, the level of debt is known with certainty for the duration of that period.

2.4. Discounting cash flow only

Using equations (2.1) and (2.2), the value of equity can be calculated as:

$$S = \{E(\mathbf{X})(1 - T) + PT - [1 + r_d(1 - T)]L\}/(1 + k_e^C) \tag{2.7}$$

Examination of equation (2.7) shows that the equity *cash flow* being discounted is after corporate tax payments but before investor-level tax payments. The discount rate, given by equation (2.2), is not dependent on the magnitude of the cash flow but it is dependent on the composition of the cash flow. That is, the discount rate is reduced if a relatively large amount of corporate tax is paid, and the resultant imputation credits distributed to equity holders. Further, and more importantly, the composition of the cash flow is reflected in the cost of equity capital via the imputation credit *yield*. That is, the value of equity is required to calculate the yield but it is the value of equity that we are trying to solve for. Although this can be solved in an iterative manner with the aid of computer spreadsheet packages, it is not a simple and inherently robust approach.

2.5. Discounting cash plus the value of imputation credits

An alternative definition of the cost of equity capital can be derived by rearranging equations (2.2) and (2.7). This approach can be expressed mathematically as:

$$S = \{E(\mathbf{X})(1 - T) + PT - [1 + r_d(1 - T)]L + \theta^d Dt_f + \theta^r RIC\}/(1 + k_e^{C+I}) \tag{2.8}$$

where

$$k_e^{C+I} = r_f + \beta^L[E(\mathbf{R_m}) - r_f] \tag{2.9}$$

Note that the numerator in this formulation corresponds to an equity *cash plus value of imputation credit stream.*

Using equations (2.3), (2.4) and (2.5), equation (2.8) can be rewritten as:

$$S = \{E(\mathbf{X})(1 - T_e) + PT_e - [1 + r_d(1 - T_e)]L\}/(1 + k_e^{C+I}) \tag{2.10}$$

The numerator in this formulation corresponds to an equity cash flow after *effective* corporate tax. However, comparing equations (2.8) and (2.10) shows that the numerator is equivalent in both equations. That is, the definition of the effective tax rate, given by equation (2.5), is such to equate a cash plus value of imputation credit stream with a cash flow after *effective* corporate tax.

The definition of the effective corporate tax rate is also consistent with the notation used in Section 2.2. In any cash plus value of imputation credit stream, the value of the imputation credits equals the value of the pre-payment of investor-level tax, as imputation credits have value only to the extent they reduce investor-level tax payments. Accordingly, a cash plus value of imputation credit stream—which is equivalent to a cash flow after *effective* corporate tax—represents an after tax cash flow plus the value of the pre-payment of investor-level tax. This is exactly the notation used in Section 2.2, namely that cash flows referred to as after *effective* corporate tax will be equal to cash flows after corporate tax *plus* the value of the pre-payment of investor-level tax.

Also as discussed in Section 2.2, the after *effective* corporate tax cash flow given by the numerator in equation (2.10) can be considered as being before investor-level tax payments.

The appropriate discount rate, or cost of equity capital, is given by equation (2.9) and is simply the classical cost of equity capital. The superscript "$C + I$" indicates that the discount rate is consistent with a cash flow plus the value of imputation credits. Importantly, this discount rate is not dependent on the magnitude or composition of the cash flow and the discount rate can be calculated in a non-iterative and straightforward manner.

2.6. *Practicability of the cost of equity capital formulations*

The practicability of the two cost of equity capital formulations, given by equations (2.7) and (2.10), can be determined by examining the variables which make-up the equations. Considering equation (2.7) first, the denominator contains the cost of equity capital applicable to a cash flow only (k_e^C) and, as discussed in Section 2.4, this discount rate can only be calculated in an iterative manner. Accordingly, this equation does not constitute a recommended valuation approach.

Equation (2.10) does not suffer the same drawback as equation (2.7) as the denominator is simply the classical cost of equity capital—which can be readily determined if the levered beta is known. The numerator of equation (2.10) can also be readily determined if the level of debt (L) is specified. Hence in these circumstances, where both the levered beta and the level of debt are specified, equation (2.10) can be applied in a simple and straightforward manner.

However, it will be seen in Section 4 that the preferred assumption in a multi-period framework is for the level of gearing to be specified in advance rather than a debt schedule. Under this assumption, the numerator of equation (2.10) can only be calculated in an iterative manner, as the amount of debt outstanding is determined by the calculated value of the company. Accordingly, equation (2.10) cannot be considered to constitute a preferred valuation methodology.

In summary, the valuation of projects and companies by discounting returns to equity holders is not recommended because both the approaches outlined involve circular calculations which must be solved iteratively.

3. Discounting project cash flows—A single-period framework

The inherent circularity associated with valuing projects by discounting returns to equity holders at the cost of equity capital can be overcome in certain circumstances by using a WACC to discount ungeared, or project, returns, and it is primarily for this reason that the WACC is the standard valuation approach.

Two WACCs are derived in this Section: one applicable to an ungeared cash flow only; and the second applicable to an ungeared cash plus value of imputation credit stream. This latter approach, of discounting cash plus the value of imputation credits or, equivalently, an ungeared cash flow after effective corporate tax, is shown to be a simple and practicable valuation method. The practicability of the WACC formulations is also discussed, and some valuation approaches are shown to be impracticable, even in the context of a single-period model.

The equations presented in this Section are derived from the equations presented in Section 2. Accordingly, the equations presented in this Section also recognise the effects of investor-level taxation. It should be noted, however, that in the WACC formulations the effects of investor-level taxation are, in general, only manifested through the cost of equity capital.

3.1. Discounting cash flow only

The derivation begins by rearranging equation (2.7), and noting that $V = S + L$, where V equals the value of the company, which results in:

$$V = [E(\mathbf{X})(1 - T) + PT]/(1 + k_w^C) \tag{3.1}$$

where

$$k_w^C = (S/V)k_e^C + (L/V)r_d(1 - T) \tag{3.2}$$

Using equation (2.6), this can be rewritten as:

$$k_w^C = (1 - \ell)k_e^C + \ell r_d(1 - T) \tag{3.3}$$

This is the standard textbook WACC, with the cost of equity capital given by equation (2.2). Again the superscript "C" indicates that the discount rate is consistent with *cash flows* only, measured after corporate tax payments but before investor-level tax payments. Note that as k_e^C is dependent on the composition, but not the magnitude, of the cash flow, k_w^C will also be dependent on the composition, but not the magnitude, of the cash flow. In this formulation, the tax deductibility of debt is reflected in the discount rate and not in the cash flow.

It should also be noted that equations (3.2) and (3.3) require k_e^C to be calculated, which, as previously discussed, is dependent on the company's (levered) imputation credit *yield* and results in a circular calculation in determining the value of equity. A related difficulty is that while the *levered* imputation credit distribution is an input to both equations (3.2) and (3.3), the cash flow being discounted is the *ungeared* cash flow to debt and equity holders which may involve a different imputation credit distribution. In fact, if a constant imputation credit payout ratio (α) is assumed then the levered imputation credit yield will in fact be lower than the ungeared imputation credit yield. Equations (3.2) and (3.3), therefore, do not lend themselves to practical examples as they require the modelling of the (levered) equity cash flow so that the levered imputation credit yield can be calculated, even though we are trying to discount an ungeared cash flow to the providers of capital. In addition, it requires an iterative approach to obtain the company's value.

3.2. Discounting cash plus the value of imputation credits

To overcome the practical difficulties of applying equations (3.1) and (3.3), an alternative WACC can be derived by rearranging equation (2.10) and noting that $V = S + L$. That is:

$$V = [E(\mathbf{X})(1 - T_e) + PT_e]/(1 + k_w^{C+I}) \tag{3.4}$$

where

$$k_w^{C+I} = (S/V)k_e^{C+I} + (L/V)r_d(1 - T_e) \tag{3.5}$$

Similar to equation (2.10), the numerator in this formulation corresponds to an ungeared *cash plus value of imputation credit stream*. This is equivalent to an ungeared cash flow after *effective* corporate tax payments but before investor-level tax payments, where the effective corporate tax rate is given by equation (2.5).

Again, the superscript "$C + I$" on the discount rate indicates that it is applicable to a cash plus value of imputation credit stream.

Using equation (2.6), equation (3.5) can be rewritten as:

$$k_w^{C+I} = (1 - \ell)k_e^{C+I} + \ell r_d(1 - T_e) \tag{3.6}$$

Equations (3.5) and (3.6) are modified versions of the standard textbook WACC, with the cost of equity capital being the classical cost of equity capital and the nominal tax rate being replaced by an effective tax rate. The discount rate can be calculated easily and it is not dependent on the composition or the magnitude of the cash flow, although it is dependent on the assumptions affecting T_e. Note that the discount rate is dependent on k_e^{C+I}, which in turn can be found by a simple and non-iterative procedure.

3.3. Practicability of the weighted average cost of capital formulations

As for the cost of equity capital formulations, the practicability of the WACC formulations can be determined by examining the variables which make-up the equations. Both equations (3.2) and (3.3) contain the cost of equity capital applicable to a cash flow only (k_e^C) and, as discussed previously, this discount rate can only be calculated in an iterative manner. Accordingly, equation (3.1), and either equation (3.2) or (3.3) do not constitute a recommended valuation methodology.

While equation (3.5) does not require the cost of equity capital applicable to a cash flow only, it does require the value of the company (V) and the value of equity (S). That is, we need to know the answer before we can calculate the discount rate, and we need the discount rate before we can calculate the answer. This iterative approach means that equations (3.4) and (3.5) do not constitute a recommended valuation approach. However, the usual approach in these circumstances is to assume a constant gearing ratio, and this is discussed below.

Equations (3.4) and (3.6) do not necessarily suffer from the two drawbacks described above. If it is assumed that the level of gearing (ℓ) is specified in advance—which will be seen to be the preferred assumption in a multi-period setting—equation (3.6) can be applied in a simple and non-iterative manner. Further, the numerator of equation (3.4) can be calculated simply even if the level of gearing is specified as it models an ungeared, or project, cash flow. That is, the potential problem of not knowing the level of debt and hence interest payments is overcome by discounting an ungeared cash flow.

Note that if the level of debt (L) is specified in advance, equations (3.4) and (3.6) cannot be applied easily. While the numerator of equation (3.4), or for that matter, equation (3.1), can be easily calculated, the calculation of an appropriate discount rate requires an iterative approach to calculate the appropriate weights for the cost of equity and the cost of debt. This applies not only to equation (3.6), but also to equations (3.2), (3.3) and (3.5).[13]

4. Extending the equations to a multi-period framework

A valuation methodology must be able to handle multi-period cash flows if it is to be considered practicable. Conceptually at least, the equations derived in a single-period framework can be extended to a multi-period setting by chaining-up the cash flows.[14] That is, in valuing multi-period cash flows, the last cash flow is discounted

[13]While beyond the scope of this paper, it should be recognised that this specification also results in the level of financial gearing changing which will change the equity beta of the company, and hence the cost of equity capital. This further complicates the analysis.

[14]See, for example, Miles and Ezzell (1980), and T.E. Copeland and J.F. Weston, *Financial Theory and Corporate Policy*, 3rd ed., Addison-Wesley Publishing Company, Reading, Massachusetts, 1988, pp. 401–411.

back one period, using the equations derived in a single-period framework, and this is added to the second last cash flow, and the sum is then further discounted, and so on.

This approach of chaining up the single-period equations also ensures that the effects of investor-level taxation are explicitly considered as the effects are included in the single-period equations.

Note that as discussed in Section 2.2, all of the equations derived in the following Sections are applicable to cash flows which can be considered as being after either actual or effective corporate tax payments, but before investor-level tax payments.

In applying the equations already derived to a multi-period setting, three issues need to be considered: the value of retained imputation credits; the debt management policy of the company; and the cash flows to equity holders.

4.1. Value of retained imputation credits

The single-period model assumed that retained imputation credits would be valued to some extent by the market. In a multi-period model this assumption is not as critical as the eventual receipt of imputation credits can be modelled by the assumed future dividend policy of the company. Accordingly, the value of retained imputation credits does not need to be considered on a period-by-period basis. However, the amount of the franking account balance should be modelled in the event that the imputation credit payout ratio is assumed to exceed unity at some point in time. The question then arises as to the value of the retained imputation credits in the last period. While they could be valued, for the sake of simplicity and with little loss of accuracy it is assumed that retained imputation credits in the last period of a multi-period cash flow will have negligible value. This assumption is also consistent with the fact that imputation credits have no value unless they are distributed to shareholders. Accordingly, our revised cost of equity capital, applicable to a multi-period cash flow and assuming that retained imputation credits in the final period are worthless, is given by rewriting equation (2.2) as:

$$E(\mathbf{r}) = r_f + \beta^L[E(\mathbf{R}_m) - r_f] - \theta D' t_f \tag{4.1}$$

where the superscript on the distributed imputation credit utilisation factor has been dropped.

Note that if it is assumed that a company will maintain a constant imputation credit payout ratio of unity or less, and that any retained imputation credits are worthless, it is unnecessary to even track the level of the franking account balance as it will not impact on value.

By noting the assumption embodied in equation (4.1), namely that $\theta^r = 0$, equation (2.5) can be rewritten as:

$$T_e = (1 - \theta\alpha)T \tag{4.2}$$

4.2. Debt management policy of the company

The second issue to be considered involves the form of the debt management policy which is assumed to be followed by the company. The existing literature[15] identifies two approaches to debt management: an active debt management policy ("ADMP") or a passive debt management policy ("PDMP"). In terms of the notation used in this paper, an ADMP corresponds to a company maintaining a pre-determined gearing ratio (ℓ). While this is usually interpreted as being constant, in general it could change over time in a pre-determined manner. Under an ADMP, the level of debt (L) in each period depends on the calculated value of the company at the beginning of the period, and this can be expressed mathematically as: $L_{i-1} = \ell_{i-1}V_{i-1}$. Alternatively, a company may be assumed to follow a PDMP which corresponds to a company maintaining a pre-specified debt schedule (i.e. L specified in advance), regardless of the outcome of future cash flows. In general, the two approaches result in different valuation equations in a multi-period setting.

Modigliani (1988) states that a PDMP seems untenable, and it seems much more reasonable to assume a company follows an ADMP. Similarly, Lewellen and Emery (1986) state that a periodic rebalancing policy wherein further borrowings depend on developing experience with company cash flows seems to be the most logical characterisation. Appleyard and Strong (1989) also express similar views. Consistent with the above views, and for the same reasons, this paper also assumes that the company follows an ADMP.

4.3. Cash flows to equity holders

The final issue to be considered involves modelling the cash flow to equity holders. In a single-period framework the cash inflow of loan funds at the end of the period (L_i) is not modelled as it is assumed that the company would be unable to borrow at this point in time. In a multi-period setting; however, this cannot be assumed and hence the cash flow to equity holders needs to be modified from that presented in equation (2.1). That is, equation (2.1) (rearranged) is changed from:

$$E(\mathbf{X}) - [E(\mathbf{X}) - P - r_d L]T - r_d L - L$$

to:

$$E(\mathbf{X}_i) - [E(\mathbf{X}_i) - P_i - r_d L_{i-1}]T - r_d L_{i-1} - L_{i-1} + L_i$$

where i is any time period between the time of valuation and the final cash flow.

[15] See, for example, G. Lewellen and D.R. Emery (1986), and T.R. Appleyard and N.C. Strong (1989).

5. Discounting project cash flows—A multi-period framework

This Section demonstrates that the WACC is a rigorous and practicable valuation methodology in a multi-period setting. In a single-period setting, it has been shown that a suitably modified textbook WACC is an appropriate discount rate for an ungeared cash plus value of imputation credit stream. Intuitively, it is expected that this modified textbook WACC will be applicable in a multi-period setting, and this is shown to be the case below.

No assumptions need be made about the constancy of the gearing ratio (ℓ) and the effective tax rate (T_e), and the equations are derived in the first instance assuming that they can change period-by-period. It has been assumed, however, that these terms are known with certainty in advance. Note that if the imputation credit payout ratio (α) and utilisation factor (θ) are constant then this implies that the effective tax rate (T_e) is also constant.

5.1. Discounting cash flows only

The derivation of a WACC applicable to ungeared *cash flows* only follows the approach used by Miles and Ezzell (1980) and begins by noting that the expected end-of-period wealth (cash flow plus value of equity) for equity holders in period i is given by: the expected after corporate tax cash flow; minus the interest and principal payments on the loan funds; plus the cash inflow from new loan drawdowns; and plus the future value of the equity of the company. Mathematically this can be represented by:

$$E(\mathbf{X}_i)(1-T) + P_iT + r_dTL_{i-1} - r_dL_{i-1} - L_{i-1} + L_i + (1-\ell_i)V_i \tag{5.1}$$

By noting $L_i = \ell_iV_i$ and $L_{i-1} = \ell_{i-1}V_{i-1}$, equation (5.1) can be rewritten as:

$$E(\mathbf{X}_i)(1-T) + P_iT - [1 + r_d(1-T)]\ell_{i-1}V_{i-1} + V_i \tag{5.2}$$

Dividing equation (5.2) through by the value of equity at the beginning of the period, $(1-\ell_{i-1})V_{i-1}$, results in one plus the return on equity capital. As equation (5.2) is defined in terms of cash flow only, the cost of equity capital is applicable to cash flow only ($k^C_{e,i}$). That is:

$$\begin{aligned}1 + k^C_{e,i} = {} & [E(\mathbf{X}_i)(1-T) + P_iT + V_i]/(1-\ell_{i-1})V_{i-1} \\ & - \{[1 + r_d(1-T)]\ell_{i-1}\}/(1-\ell_{i-1})\end{aligned} \tag{5.3}$$

The first term on the right hand side of equation (5.3) is one plus the weighted average cost of capital applicable to a cash flow only divided by $(1-\ell_{i-1})$, or $(1 + k^C_{w,i})/(1-\ell_{i-1})$. Accordingly, equation (5.3) can be rearranged to yield:

$$k^C_{w,i} = (1-\ell_{i-1})k^C_{e,i} + \ell_{i-1}r_d(1-T) \tag{5.4}$$

This discount rate is applicable to ungeared, or project, cash flows only, for any time period (i). Accordingly, a general valuation formula can be written using equation (5.4) as:[16]

$$V_0 = \sum_{i=1}^{n} \left\{ [E(\mathbf{X}_i)(1 - T) + P_i T] / \prod_{j=1}^{i} (1 + k_{w,j}^{C}) \right\} \tag{5.5}$$

Under this valuation approach, the discount rate is changing each period, even if the leverage ratio (and the levered beta) are assumed constant. This is because the cost of equity capital applicable to a cash flow only is a function of the composition of the cash flows and requires an iterative approach to determine its value, and hence the weighted average cost of capital applicable to cash flows only is also a function of the composition of the cash flows and also requires an iterative approach. As discussed for the single-period case, this makes the application of equations (5.4) and (5.5) impracticable. However, this approach is consistent with that in the single-period case.

5.2. Discounting cash plus the value of imputation credits

The derivation of a WACC applicable to an ungeared *cash plus value of imputation credit stream* follows the approach used in Section 5.1 and begins by noting that the expected end-of-period wealth (cash flow plus value of imputation credits plus value of equity) for equity holders in period i is given by: the expected after corporate tax cash flow; plus the (levered) value of the (distributed) imputation credits; minus the interest and principal payments on the loan funds; plus the cash inflow from new loan drawdowns; and plus the future value of the equity of the firm. Mathematically this can be represented by:

$$E(\mathbf{X}_i)(1 - T) + P_i T + r_d T L_{i-1} + \theta_i D_i t_{fi} - r_d L_{i-1} - L_{i-1} + L_i + (1 - \ell_i) V_i \tag{5.6}$$

By noting $L_i = \ell_i V_i$, $L_{i-1} = \ell_{i-1} V_{i-1}$ and the definition of T_e, equation (5.6) can be rewritten as:

$$E(\mathbf{X}_i)(1 - T_{e,i}) + P_i T_{e,i} - [1 + r_d(1 - T_{e,i})]\ell_{i-1} V_{i-1} + V_i \tag{5.7}$$

Dividing equation (5.7) through by the value of equity at the beginning of the period, $(1 - \ell_{i-1})V_{i-1}$, results in one plus the return on equity capital. As equation (5.7) is defined in terms of cash plus value of imputation credits, the cost of equity capital is applicable to a cash plus value of imputation credit stream ($k_{e,i}^{C+I}$). That is:

[16]This approach is equivalent to the method employed by Officer (1994) in approach B (i)—one of the five approaches outlined in his paper. However, the WACC as given by equation (5.4) bears little relationship to the WACC given in Officer's paper.

$$1 + k_{e,i}^{C+I} = [E(\mathbf{X}_i)(1 - T_{e,i}) + P_i T_{e,i} + V_i]/(1 - \ell_{i-1})V_{i-1} \\ - [(1 + r_d(1 - T_{e,i}))\ell_{i-1}]/(1 - \ell_{i-1}) \tag{5.8}$$

The first term on the right hand side of equation (5.8) is the weighted average cost of capital applicable to a cash plus value of imputation credit stream divided by $(1 - \ell_{i-1})$, or $(1 + k_{w,i}^{C+I})/(1 - \ell_{i-1})$. Accordingly, equation (5.8) can be rearranged to yield:

$$k_{w,i}^{C+I} = (1 - \ell_{i-1})k_{e,i}^{C+I} + \ell_{i-1}r_d(1 - T_{e,i}) \tag{5.9}$$

This discount rate is applicable to an ungeared, or project, cash flow (after corporate tax payments) plus value of imputation credit stream, for any time period (i). Accordingly, and by using equation (5.9), a general valuation formula which is applicable to ungeared cash flows after *effective* corporate tax can be written as:

$$V_0 = \sum_{i=1}^{n} \left\{ [E(\mathbf{X}_i)(1 - T_{e,i}) + P_i T_{e,i}] / \prod_{j=1}^{i} (1 + k_{w,j}^{C+I}) \right\} \tag{5.10}$$

If the imputation credit payout ratio, utilisation factor and leverage ratio are assumed to be constant, equation (5.9) can be rewritten as:

$$k_w^{C+I} = (1 - \ell)k_e^{C+I} + \ell r_d(1 - T_e) \tag{5.11}$$

As for the single-period case, equations (5.10) and (5.11) can be calculated in a non-iterative and straightforward manner if the level of gearing (and the levered beta) are known.[17] As it has been assumed that the level of gearing is known, these equations represent a practicable valuation methodology in a multi-period setting.[18]

5.3. Practicability of the WACC formulation

The comments made in Section 3.3 about the practicability of the WACC formulation in the single-period setting apply equally in a multi-period setting. This Section effectively summarises those earlier comments that are applicable to a multi-period setting.

As previously discussed, the discounting of ungeared cash flows only results in a circular calculation and hence is not a recommended valuation approach.

The discounting of an ungeared cash plus value of imputation credit stream, or, equivalently, an ungeared cash flow after effective corporate tax, as given by equation (5.10), is a non-iterative and straightforward process if the level of gearing is specified. As has been discussed, this is assumed to be the case in a multi-period

[17] This approach is consistent with the method employed by Officer (1994) in approach B (ii)—where Officer's γ equals θ times α in the notation of this paper.

[18] Although beyond the scope of this paper, a levered beta can be calculated simply from an asset beta if the level of gearing is specified.

setting. This valuation approach results in a discount rate that is independent of the magnitude, timing and composition of the cash flows and, with reasonable assumptions, is constant over time.

Accordingly, the discounting of an ungeared, or project, cash flow after effective corporate tax using a modified textbook WACC is a practicable and rigorous valuation methodology. It is applicable to either: (i) a single-period cash flow; or (ii) multiple, non-uniform cash flows; and, (iii) given the preceding point, constant in-perpetuity cash flows. That is, the modified textbook WACC is a very robust valuation technique.

5.4. Boundary conditions

If it is assumed that imputation credits are worthless ($\theta = 0$), equations (5.9) and (5.11) revert to the classical WACC.

If it is assumed that imputation credits are fully valued by the market ($\theta = 1$) and that all imputation credits are distributed ($\alpha = 1$), the effective corporate tax rate equals zero and equation (5.10) can be rewritten as:

$$V_0 = \sum_{i=1}^{n} \left\{ [E(\mathbf{X}_i)] / \prod_{j=1}^{i} (1 + k_{w,j}^{C+I}) \right\} \tag{5.12}$$

where

$$k_{w,j}^{C+I} = (1 - \ell_{j-1}) k_{e,j}^{C+I} + \ell_{j-1} r_d \tag{5.13}$$

Equation (5.12) shows that under this (extreme) assumption, pre-tax cash flows can be discounted at a WACC modified by the absence of the $(1 - T_e)$ term, corresponding to the removal of the tax shield of debt.[19]

6. Discounting equity cash flows—A multi-period framework

To complete the circle, this Section will consider the discounting of returns to equity holders in a multi-period setting.

6.1. Discounting cash flow only

Where the equity *cash flow* only is being discounted, the value of equity of a levered company is given by:[20]

[19]In applying equation (5.13), however, care must be taken in the calculation of k_e^{C+I}, or more precisely β^L. The change in the effective tax rate (T_e) caused by the assumption that $\theta = 1$ means that β^L will increase if a constant asset beta is assumed. However, it can be shown that the effect of this change is likely to be very small.

[20]A proof of this equation and equation (6.2) is available from the author on request.

$$S_0 = \sum_{i=1}^{n} \left\{ [E(\mathbf{X}_i)(1-T) + P_i T - L_{i-1}(1+r_d(1-T)) + L_i] / \prod_{j=1}^{i} (1+k_{e,j}^{C}) \right\} \tag{6.1}$$

As discussed for the single-period case, the discount rate in this equation is a function of the composition of the cash flows.

6.2. *Discounting cash plus the value of imputation credits*

Where the *cash plus value of imputation credit stream* to equity holders is being discounted, and assuming the company maintains a constant leverage ratio, the value of equity of a levered company can be written as:

$$S_0 = \sum_{i=1}^{n} \left\{ [E(\mathbf{X}_i)(1-T_{e,i}) + P_i T_{e,i} - L_{i-1}(1+r_d(1-T_{e,i})) + L_i] / (1+k_e^{C+I})^i \right\} \tag{6.2}$$

Importantly, this approach results in a discount rate which does not depend on the composition of the cash flows, nor does it depend on the imputation credit payout ratio and utilisation factor as any changes to these variables are reflected in the returns to equity holders only and do not impact on the discount rate.

Equation (6.2) also shows that a project can be valued by discounting an equity cash flow after *effective* corporate tax at the company's classical cost of equity capital. Note that a cash flow after *effective* corporate tax is equivalent to a cash plus value of imputation credit stream.

6.3. *Practicability of the cost of equity capital formulation*

As for the single-period framework, both cost of equity capital valuation approaches result in a circular calculation in determining the numerator, or the returns to equity holders, if the level of gearing (ℓ) is specified. In addition, the discounting of an equity cash flow stream only requires the imputation credit yield to be determined via a circular calculation.

Accordingly, and as for the single-period case, neither valuation approach is recommended.

7. Recommended approach

This Section reviews the alternative valuation approaches and sets out what the author considers to be the most practicable approach to valuing projects and companies under a dividend imputation tax system. This approach is applicable to non-uniform cash flows of finite duration.

7.1. Review of alternative approaches

Discounting returns to equity holders, be they cash flow only or cash plus the value of imputation credits, was shown to be impracticable in both the single-period and multi-period frameworks.

The discounting of ungeared, or project, cash flows only using a WACC was also shown to be impracticable in both the single-period and the multi-period settings.

The discounting of an ungeared, or project, cash plus value of imputation credit stream using a modified WACC was shown to a practicable valuation methodology in both the single-period and multi-period frameworks where the level of gearing was specified, which has been assumed to be the case in a multi-period setting. Accordingly, a valuation approach using a modified WACC—where the nominal tax rate is replaced by an effective tax rate in calculating both the cash flow and the discount rate—is a practicable valuation methodology in a multi-period setting and is the author's recommended approach under the dividend imputation tax system.

7.2. Recommended approach

The recommended approach uses a modified WACC to discount an ungeared cash plus value of imputation credit stream, or, equivalently, an ungeared cash flow after effective corporate tax, and essentially involves the application of equations (5.10) and (5.11). This ungeared cash flow can be considered as being measured before investor-level tax payments. Importantly, this approach is applicable to non-uniform cash flows of finite duration. The approach set out below assumes that the value of imputation credits, the imputation credit payout ratio and the level of gearing are constant over time.

The six step approach can be summarised as follows:

(i) estimate the value of imputation credits (θ);[21]

(ii) estimate an imputation credit payout ratio (α);[22]

(iii) calculate an effective corporate tax rate by using equation (4.2);

(iv) calculate an ungeared cash flow after effective corporate tax payments, pre investor-level tax payments. This can be calculated in two ways:

[21]Empirical estimates of this figure suggest a value of around 0.7 may be applicable. See K. Bruckner, N. Dews and D. White, "Capturing Value from Dividend Imputation", *McKinsey & Company*, 1994.

[22]In estimating this, the historical rate of distribution of imputation credits may prove useful, along with any announcements by the company on its attitude to the distribution of imputation credits. Intuitively, this value could approach unity for many companies.

- by simply undertaking the numerical calculations as though the corporate tax rate were the effective corporate tax rate (given by step (iii)); or
- by calculating the ungeared after corporate tax cash flow, using the nominal or statutory corporate tax rate, and adding back a percentage of the corporate tax paid, representing the value of imputation credits distributed to shareholders. The percentage of corporate tax paid which is added back is given by the product of the value of imputation credits (given by step (i)) and the imputation credit payout ratio (given by step (ii));

(v) calculate a modified WACC using the effective tax rate calculated above and equation (5.11); and

(vi) discount the cash flows in the usual manner.

This approach essentially involves the use of an effective tax rate, defined by equation (4.2), in calculating both the after tax cash flows to the providers of capital, and the WACC.

7.3. Initial capital requirements

Projects usually require an initial capital expenditure to secure the future cash flows which are then subject to discounting. While the treatment of this initial capital expenditure requirement has not yet been explicitly considered in the analysis, the effects are relatively straightforward and, in the main, simply involve the subtraction of the amount of the initial capital from the project's value. The main point worth noting is that the valuation equations derived in this paper are applicable to the present value of the cash flows and not the *net* present value. That is, where the value of equity is required in equations, such as in calculating dividend yield, the value of equity required is that value before the deduction of any initial capital expenditure requirements. An initial capital investment is considered in the worked example.

7.4. Worked example

Appendix 1 sets out a series of cash flows that might typically apply to a five year project and these are valued according to the recommended approach outlined above. In addition, Appendix 2 sets out alternative valuation approaches which demonstrates the consistency of the valuation approaches outlined in this paper.

8. Conclusion

This paper set out to derive a rigorous and practicable method for valuing Australian companies and projects under the Australian dividend imputation tax system. This was achieved and it was shown that a modified textbook WACC approach can be applied easily in practical situations.

The modified textbook WACC approach involves adjusting the nominal, or statutory, tax rate to an effective tax rate in both (i) the discount rate, and (ii) the calculation of the ungeared, or project, cash flows to the providers of capital. The effective tax rate was shown to be a function of the imputation credit payout ratio and utilisation factor, and the nominal tax rate. The calculation of after tax cash flows using an effective tax rate was shown to be equivalent to calculating a cash plus value of imputation credit stream.

It was demonstrated that this approach was applicable to non-uniform returns of finite duration. Further, the approach was derived in the context of the Australian dividend imputation tax system where investor-level taxes were explicitly considered. Finally, the discount rate was shown to be independent of the magnitude, timing and composition of the cash flows, and given a reasonable set of assumptions, to be constant over time.

Appendix 1

Set out below is a worked example which demonstrates the recommended valuation method.

	$t=0$	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$
A. Initial investment and pre-tax cash flows						
Assumed initial investment	(75.00)					
Assumed operating cash flow before interest and tax		100.00	110.00	121.00	133.10	146.41
B. Tax payments						
I. Tax rates						
Statutory (actual) corporate tax rate		36.0%	36.0%	36.0%	36.0%	36.0%
Assumed utilisation factor of imputation credits		0.50	0.50	0.50	0.50	0.50
Assumed payout ratio of imputation credits		100.0%	100.0%	100.0%	100.0%	100.0%
Effective corporate tax rate		18.0%	18.0%	18.0%	18.0%	18.0%
II. Calculated tax payments						
Cash flow before interest and tax		100.00	110.00	121.00	133.10	146.41
Plus depreciation		(25.00)	(25.00)	(25.00)	0.00	0.00
Taxable income on ungeared cash flow		75.00	85.00	96.00	133.10	146.41
Effective corporate tax paid on ungeared cash flow		13.50	15.30	17.28	23.96	26.35
C. Ungeared cash flows after effective corporate tax						
Operating cash flow before interest and tax	(75.00)	100.00	110.00	121.00	133.10	146.41
Plus effective corporate tax paid on ungeared cash flow		(13.50)	(15.30)	(17.28)	(23.96)	(26.35)
Effective after tax ungeared cash flow	(75.00)	86.50	94.70	103.72	109.14	120.06
D. Other assumptions						
Debt to value of firm ratio (*L/V*)		0.50	0.50	0.50	0.50	0.50
Risk-free interest rate		10.00%	10.00%	10.00%	10.00%	10.00%
Company's cost of debt		11.00%	11.00%	11.00%	11.00%	11.00%
Market risk premium		6.00%	6.00%	6.00%	6.00%	6.00%
E. Discount rates						
I. Beta						
Geared equity beta		1.00	1.00	1.00	1.00	1.00
II. Cost of equity capital						
Classical cost of equity capital		16.00%	16.00%	16.00%	16.00%	16.00%
III. WACC						
Applicable to cash plus imputation credits		12.51%	12.51%	12.51%	12.51%	12.51%
F. Valuation—WACC						
Effective after tax ungeared cash flow	(75.00)	86.50	94.70	103.72	109.14	120.06
Discount rate		12.51%	12.51%	12.51%	12.51%	12.51%
Value of project	284.23	359.23	317.66	262.70	191.85	106.71

Appendix 2

Set out below is a worked example which demonstrates the consistency of the valuation techniques presented in this paper. Also shown in Part H of this example is the project value if it is assumed that imputation credits are fully valued by the market.

	$t=0$	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$
A. Initial investment and pre-tax cash flows						
Assumed initial investment	(75.00)					
Assumed operating cash flow before interest and tax		100.00	110.00	121.00	133.10	146.41
B. Tax payments						
I. Tax rates						
Statutory (actual) corporate tax rate		36.0%	36.0%	36.0%	36.0%	36.0%
Assumed utilisation factor of distributed imputation credits		0.50	0.50	0.50	0.50	0.50
Assumed payout ratio of imputation credits		100.0%	100.0%	100.0%	100.0%	100.0%
Effective corporate tax rate		18.0%	18.0%	18.0%	18.0%	18.0%
II. Calculated tax payments						
Cash flow before interest and tax		100.00	110.00	121.00	133.10	146.41
Plus depreciation		(25.00)	(25.00)	(25.00)	0.00	0.00
Taxable income on ungeared cash flow		75.00	85.00	96.00	133.10	146.41
Plus interest payments		(19.76)	(17.47)	(14.45)	(10.55)	(5.87)
Taxable income on geared cash flow		55.24	67.53	81.55	122.55	140.54
Actual corporate tax paid on ungeared cash flow		27.00	30.60	34.56	47.92	52.71
Actual corporate tax paid on geared cash flow		19.89	24.31	29.36	44.12	50.59
Effective corporate tax paid on geared cash flow		9.94	12.16	14.68	22.06	25.30
C. Cash flows to capital providers						
I. Ungeared actual cash flow to providers of capital						
Operating cash flow before interest and tax	(75.00)	100.00	110.00	121.00	133.10	146.41
Plus actual corporate tax paid on ungeared cash flow		(27.00)	(30.60)	(34.56)	(47.92)	(52.71)
Actual after tax ungeared cash flow	(75.00)	73.00	79.40	86.44	85.18	93.70
II. Cash flows to equity holders (geared)						
Operating cash flow before interest and tax	(75.00)	100.00	110.00	121.00	133.10	146.41
Plus effective corporate tax paid on geared cash flow		(9.94)	(12.16)	(14.68)	(22.06)	(25.30)
Plus payments to debt holders	179.61	(40.54)	(44.95)	(49.88)	(53.12)	(59.22)
Effective cash flow to equity holders	104.61	49.52	52.89	56.44	57.92	61.89
Operating cash flow before interest and tax	(75.00)	100.00	110.00	121.00	133.10	146.41
Plus actual corporate tax paid on geared cash flow		(19.89)	(24.31)	(29.36)	(44.12)	(50.59)
Plus payments to debt holders	179.61	(40.54)	(44.95)	(49.88)	(53.12)	(59.22)
Actual cash flow to equity holders	104.61	39.57	40.74	41.76	35.86	36.59

	$t=0$	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$
III. Cash flows to debt holders						
Interest payments	0.00	19.76	17.47	14.45	10.55	5.87
Repayments of principal	0.00	179.61	158.83	131.35	95.92	53.35
Plus drawdown of principal	(179.6)	(158.8)	(131.4)	(95.92)	(53.35)	0.00
Total cash flow to debt holders	(179.6)	40.54	44.95	49.88	53.12	59.22
D. Imputation credit distributions						
Actual corporate tax paid on geared cash flow		19.89	24.31	29.36	44.12	50.59
Imputation credits distributed		19.89	24.31	29.36	44.12	50.59
Effective value of distributed imputation credits		9.94	12.16	14.68	22.06	25.30
E. Other assumptions						
Debt to value of firm ratio (*L/V*)		0.50	0.50	0.50	0.50	0.50
Risk-free interest rate		10.00%	10.00%	10.00%	10.00%	10.00%
Company's cost of debt		11.00%	11.00%	11.00%	11.00%	11.00%
Market risk premium		6.00%	6.00%	6.00%	6.00%	6.00%
F. Discount rates						
I. Beta						
Geared equity beta		1.00	1.00	1.00	1.00	1.00
II. Cost of equity capital						
Classical cost of equity capital		16.00%	16.00%	16.00%	16.00%	16.00%
Cost of equity capital applicable to cash flows only[a]		10.46%	8.35%	4.82%	−7.00%	−31.4%
III. WACC						
Applicable to cash flow only		8.75%	7.69%	5.93%	0.02%	−12.2%
G. Valuation methodologies						
I. Valuation of cash flows using WACC						
Actual after tax ungeared cash flow	(75.00)	73.00	79.40	86.44	85.18	93.70
Discount rate		8.75%	7.69%	5.93%	0.02%	−12.2%
Value of project	284.23	359.23	317.66	262.70	191.85	106.71
Value of equity	284.23	179.61	158.83	131.35	95.92	53.35
II. Valuation of cash flows using cost of equity capital						
Effective cash flow to equity holders	104.61	49.52	52.89	56.44	57.92	61.89
Discount rate		16.00%	16.00%	16.00%	16.00%	16.00%
Value of equity	284.23	179.61	158.83	131.35	95.92	53.35
Actual cash flow to equity holders	104.61	39.57	40.74	41.76	35.86	36.59
Discount rate		10.46%	8.35%	4.82%	−7.00%	−31.4%
Value of equity	284.23	179.61	158.83	131.35	95.92	53.35
H. Project value if imputation credits fully valued						
Pre-tax cash flows	(75.00)	100.00	110.00	121.00	133.10	146.41
Modified WACC		13.50%	13.50%	13.50%	13.50%	13.50%
Value of project	339.18	414.18	370.10	310.06	230.92	129.00

[a]These values are calculated using equation (4.1). For this example, the cost of equity capital applicable to the cash flow at $t = 5$ is given by: $k_e^C = r_f + \beta^L[E(\mathbf{R}_m) - r_f] - \theta D't_f = 0.10 + 1.0 * 0.06 - 0.50 * 50.59 / 53.35 = 0.314 = 31.4\%$, where, as described in Section 2.2, $D't_f$ is given by the amount of imputation credits distributed (50.59) divided by the value of equity (53.35).

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