NOTES ON THE COST OF CAPITAL IN IRELAND

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Much public discussion focusses on movements in the cost to firms of labour and its impact on growth, employment and the balance of payments. Comparatively neglected is the cost of servicing capital inputs. Yet this is strongly influenced by policy measures and can affect the incentive for capital formation, especially for labour saving investment. For a variety of reasons, but mainly due to the interaction of high rates of inflation with an unindexed tax regime, the rental equivalent cost of capital fell in real terms during the 1970s. This fall suggests a ready explanation for what have been described as high incremental capital-output ratios in Ireland in recent years. Instead of investment being relatively unproductive, it could well be that it was labour saving rather than expansionary in character. In this article we do not address this question directly, but merely discuss the difficulties of measuring the cost of debt capital in Ireland.

Recent papers by Geary, Walsh and Copeland (1975), Geary and McDonnell (1979) and Ruane (1982) have reviewed aspects of the cost of debt capital in Ireland. However, for the most part they were concerned with a non-inflationary world. We believe that high rates of inflation have had important effects on the cost of capital which have not yet been adequately explored.

This study is organised as follows: Section 1 reviews the basic concepts involved in evaluating the cost of debt capital. Section 2 tackles the puzzling question of negative cost of capital figures. In Section 3 we point out how capital grants may operate as labour subsidies. Section 4 explores techniques of tax avoidance involving the special financing arrangements known as "tax-based lending". The appropriate treatment of depreciation is discussed in Section 5, and numerical values for the cost of capital in Ireland in the 1970s are given in Section 6 together with some conclusions.

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1: The Cost of Capital

In choosing the amount of labour input, the neoclassical firm hires labour to the point where wage costs equal the value marginal product of labour. In just the same way, the value marginal product of capital is equalised to the cost of using a unit of capital. In the case of capital, of course, the asset is long-lived, and one must think in terms either of the discounted present value of costs – and marginal products – or, as we do here, in terms of a constant real flow. Measuring this "cost of capital" clearly involves interest rates, tax concessions, and possibly grants which would be available to the investor.[1]

Several authors have in recent years reviewed the cost of capital for the Irish economy and all agree on the general principles, but an important semantic point must be made at this juncture, between what is discussed here and finance theory usage of the term "cost of capital". In the same tradition as that followed by Geary and McDonnell and Ruane, we are evaluating the annual rental equivalent of the cost of servicing capital investment. This includes an allowance for repayment of debt (or, in other presentation, depreciation). Thus we do *not* arrive at the discount rate at which the net cash flows, including outlays for replacement of capital equipment, should be discounted as to obtain the net present value of a particular project. That discount rate is generally termed "the cost of capital" in finance theory. Thus, the one-year cost of new capital is made up of three elements: interest costs on the debt incurred to acquire the capital, depreciation costs arising out of capital consumption, and possible gains or losses due to price changes. In all cases we are interested in *ex ante* values of the elements of the cost of capital. In other words, we want to know what the businessman expected the use of capital to cost him before the event.

So far as interest rates are concerned, the important points to notice are that interest is paid only on the cost of investment net of any initial depreciation allowances and grants, since the tax saved on initial depreciation and the grants received may be set against the cost of acquiring the capital.[2] Note also that interest charges are typically allowable against income or corporation tax. If the capital deteriorates during the year, whether in terms of productive capacity or likely remaining lifetime, a depreciation charge reflecting this deterioration must be included in the cost of using the capital. An amount is allowable against tax in respect of depreciation according to a schedule embodied in tax legislation. If there is a change over and above what has been allowed for in the depreciation charge in the price of the capital good relative to the average price of goods in the economy then, so long as this change has

been anticipated, it should be included in the (*ex ante*) cost of capital. However, if relative prices have not changed, it is not appropriate to include a separate capital gains term.

General inflation does, however, affect the cost of capital. This point is often neglected. It reflects the fact that, for new debt, the nominal rate is typically higher in inflationary times than in times of price stability. Part of the interest payments in inflationary times serve to compensate the borrower for the reduction over time, due to inflation, in the real value of the capital sum borrowed. In effect then that part of the interest payment is an advance repayment of debt, rather than being a true or real interest rate. Only the real interest rate – being the nominal interest rate less the expected rate of inflation – should be counted as an interest charge in the cost of capital. However, the tax code allows the full nominal interest payment to be deducted from income before payment of tax. A higher rate of inflation may not change the real rate of interest, but will increase the tax saving by resulting in a higher nominal interest rate. Our approach to the cost of capital differs from that of previous authors in several respects which are numerically quite significant. Among the more important differences are the following.[3] On *interest costs*, previous measures of the cost of capital for Ireland have not distinguished between real and nominal interest rates.[4] Ruane's (1982) theoretical framework had no inflation, but she presented no numerical values, so her discussion is not at fault on this point. Geary and McDonnell (1979) – GM – make their calculations on the basis of nominal instead of real interest rates.

On *depreciation*, we think the rate used by GM was too low. The rate they used was their estimate of the amount of capital becoming obsolete after a fixed life, expressed as a proportion of the current capital stock. Since the capital stock is growing, this is a considerable understatement of the true economic depreciation rate on any given item of capital equipment, which is what should appear in the cost of capital. On *price changes*, GM assume that the whole of the absolute change in the price of investment goods is a change in the relative price of capital goods. Also, they caution against assuming that these price changes were anticipated, a caution which subsequent researchers appear to have interpreted as meaning that they should not use the series which takes account of price changes. Introduction of inflation also introduces the need to annuitise constant nominal cash flows into constant real flows of equal value. Some consideration must also be given to making an allowance for the cost of increased leverage involved in availing of tax allowances on borrowing.

2: Negative Cost of Capital

The possibility of a negative cost of capital arises obviously when the real rate of interest is negative, but can also occur even if the real rate of interest is positive. What sense can we make of a situation where the cost of capital figures are negative? There are four main possibilities. The first is capital rationing. Unlimited funds may not be available at the rates specified so that the true marginal cost of funds may be greater than specified. Second, there is a limit to the capacity of firms to benefit from tax shields. It is the existence of tax shields on nominal interest payments that has been the greatest factor tending to produce negative cost of capital figures. When profits before interest are less than interest payments, the tax shield may not be as valuable to the firm as is computed in our formula. However tax avoidance schemes based on borrowing from financial institutions can often restore the value of the tax shield, as we will see in a later section.

The third possibility is that the computed figures do not take enough account of risk. The assumption of a debt involves the risk that the capital good might not continue to yield the expected stream of returns and hence might lead to financial distress. Our method of taking account of this has been to apply a leverage discount to the tax yields which can only be obtained through fixed interest financing. This is in line with standard practice in the finance theory, but is not customary in mainline economics literature. A further risk concerns the continuation into the future of tax shields whose value depends heavily on the rate of inflation. While all of the elements in the cost of capital may be subject to uncertainty, this is likely to be the most volatile. Applying a further discount for this would be numerically much the same as increasing the leverage discount. Previous estimates of the cost of capital have not included a risk factor, and we suspect that their relative lack of success in econometric work may be attributable to this omission. Furthermore, recognition of the fact that the real value of the tax shields declines over time during an inflationary period significantly reduces the incidence of negative measured cost of capital. This point has been neglected in previous work. Finally, we must not forget that our measures of the cost of capital are necessarily imperfect, involving as they do the expectations of businessmen. Perhaps we obtain negative numbers simply because we have not accurately measured these expectations.

3: Capital Grants as Labour Subsidies

This article has so far avoided discussion of the impact of cost of capital on the demand for factors. One important aspect of this problem should not, however, be neglected, and this is the question of IDA capital

grants. While these may be expressed as a proportion of fixed capital investment, it is the policy of the IDA not to exceed a certain "cost per job" in deciding its grants. There are exceptions to this policy, of course, but it remains true that a very capital intensive project will generally obtain a very low grant as a percentage of the net capital investment involved. If the grant rate is inversely proportionate to the capital-labour ratio in the project, then this dependence must be taken into account in assessing the impact of the cost of capital on the demand for factors. It is easy to show in simple cases that the dependence of grants on the capital-labour ratio reduces the optimal capital-labour ratio for the investing company. It also reduces the sensitivity of the optimal capital-labour ratio to the relative factor prices exclusive of the grant element. The argument that IDA grants subsidise capital rather than labour has to be qualified in the light of this consideration. The fact that these grants are expressed as capital grants conceals some of their true effect on factor demand. This is not to say that payments of grants in this way is the most effective means of subsidising labour. There may be problems with ensuring that the actual capital-labour ratio remains as low as planned, or even in ensuring that the targetted employment levels are reached when the grants are explicitly related to fixed asset investment. A full discussion of these issues would take us too far afield.

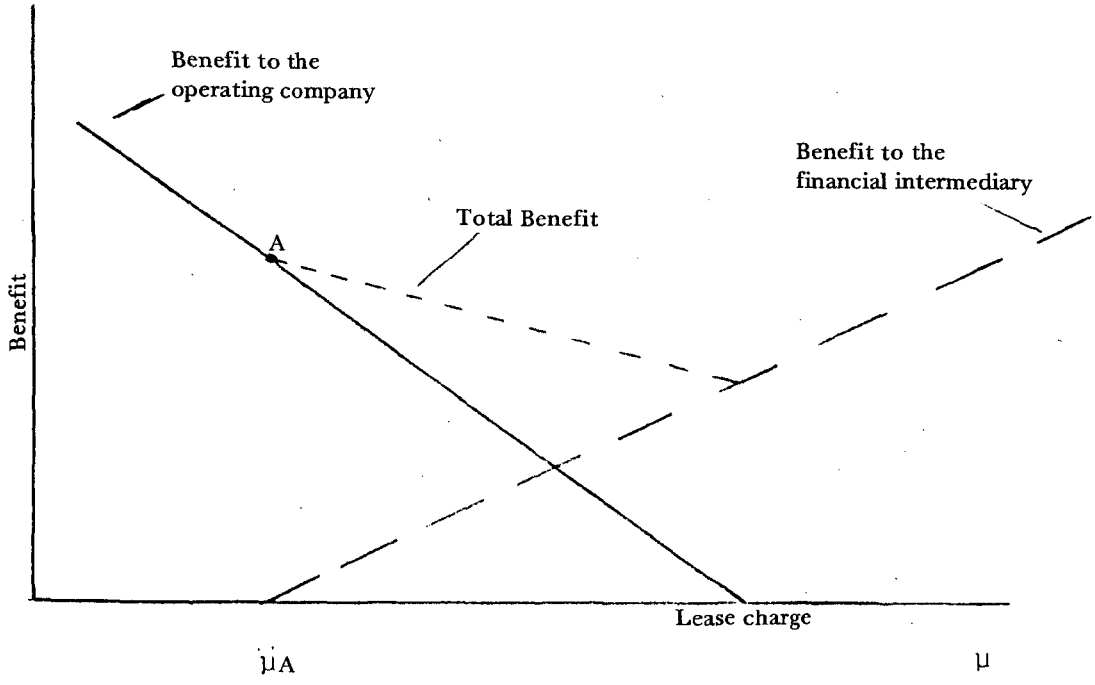
4: Tax-Based Lending

An important feature of financial arrangements relating to investment has been the use of tax-based lending facilities. These are essentially financing packages drawn up in such a way as to transfer tax concessions from (borrowing) companies liable to zero or low rates of corporation tax to financial intermediaries liable to a higher rate of corporation tax. Two important types of tax-based lending arrangements are finance leasing and the "section 84" loan. We need not be concerned with the precise details of such arrangements, which vary from case to case. The finance lease is an arrangement whereby the financial intermediary carries out the investment and obtains the depreciation allowances, but leases the equipment to the operating company. For the section 84 loan, there is no relationship with a particular investment, but the interest payments, which vary to some, usually negligible, extent depending on the profits of the operating company, are treated as non-taxable in the hands of the financial intermediary. (The introduction of Advance Corporation Tax and other recent changes have somewhat altered the position with regard to the schemes we discuss in this section).

The question of the circumstances under which different types of operating company will find leasing or section 84 loans attractive has been considered (from different angles) by Stewart (1982) and Ruane and John (1983). However, they do not examine the differential benefits of the tax saving to the operating company and to the financial intermediary. Consider first the lease. To simplify, we assume that the lease is for the expected lifetime of the investment good and that the payment, per unit of investment, by the operating company to the financial intermediary is a nominal μ per annum. This charge μ can not be so large that it makes the cost of financing by lease greater, in after tax terms, than that of financing by a conventional loan. On the other hand it cannot be so low that it yields a smaller after-tax profit to the financial intermediary. These considerations provide an upper and a lower bound to the leasing charge. As we have shown elsewhere, only if the charge is at its lowest bound can be assume that the lease will give the operating company a cost of capital the same as if it were undertaking a conventional loan subject to corporation tax at the same rate as the financial intermediary. (Nevertheless, this is the assumption made by Ruane and John 1983).

Furthermore, it is not possible to speak of the operating company and the financial intermediary "dividing the advantage of the lease between them". This is because, for every £100 additional after-tax profit by the financial institution, there is a greater loss – of up to £180 – to the operating company. Put another way, every extra pound given by the operating company to the financial intermediary will involve a heavier tax burden. This point, which is proved in our earlier paper, is illustrated in Figure 1, which displays the after-tax profits on the leasing deal (relative to a conventional loan) for the operating company and the financial intermediary as a function of the lease charge μ. Since the total net benefit of the leasing deal is not independent of the financial intermediary's share, one should apply caution in interpreting such statements as "the banks take only x per cent. of the total benefit". If the "total benefit" is the maximum total benefit, (i.e. point A in Figure 1) this could only be achieved if the lease charge were μ_A, so that the financial intermediary can never take more than about one-half of the benefit (at current tax rates). The situation with regard to section 84 loans is somewhat easier to analyse and leads to the same sort of conclusion. The possibility of a beneficial transaction of this type exists so long as the marginal tax rate on the operating company falls short of that on the financial intermediary.

Figure 1: *After Tax Benefit of Leasing*



5: Depreciation

The appropriate depreciation rate depends on one's assumption concerning the lifetime of the capital good and the question of deterioration over time. The generally accepted view for Ireland [Vaughan, 1981] seems to be that a "one-horse shay" or "sudden death" assumption is the most plausible simplification of capital stock deterioration. This assumption amounts to saying that capital stock is as good as new until its retirement date. It should be noted that the retirement date of capital may not be entirely determined by technological considerations but may be influenced by price and demand expectations. These refinements are beyond the scope of this article. Now of course the ageing of an asset does not impose a cash cost in itself. But the cost of capital figure is the constant real stream which, over the lifetime of the asset, must be set against the marginal product of the asset to assess profitability. Thus it is essentially principal repayments on the borrowings assumed to finance purchase of the asset which should be annuitised into a constant real stream over the life of the asset. (At least this is the case for sudden death – somewhat different formulations can be envisaged for more complex types of asset deterioration.)

An ambiguity arises when we consider the question of replacement: we can compute the cost of capital either for a time horizon equal to the life of the asset, or for an infinite horizon. The two calculations amount to the same thing if the asset can be replaced on the same terms (initial allowance, grant) as when originally required. However, if a greater real sum must be borrowed at time of replacement, then the infinite horizon cost of capital will be higher by virtue of the necessity to apply a depreciation rate which will finance the extra borrowing for replacement. As such calculations relate to the remote future, we consider it advisable to confine ourselves to the finite time horizon (equal to life of asset) approach. If the life of the asset is assumed to be T years, then the annual sum, per £ borrowed, which must be set aside (and invested at an assumed constant real rate of interest) as a depreciation charge in order to have repaid the initial loan at the end of T years is shown in table 1. The tax shield provided in respect of depreciation has little to

Table 1: *Depreciation Rate for Various Asset Lives, Interest Rates*

Life (years) T	3	5	10	15	20	40
Real interest rate (per annum r*)						
0.01	32.8	19.5	9.5	6.2	4.5	2.0
0.02	32.3	19.0	9.0	5.7	4.1	1.6
0.03	31.9	18.5	8.6	5.3	3.6	1.3
0.05	30.9	17.6	7.7	4.5	2.9	0.8
0.10	28.6	15.4	5.8	2.9	1.6	0.2

do with the above discussion. In practice the tax laws specify the depreciation allowable against tax. As initial allowances have grown, however, the importance of this allowance has diminished, since in most cases the sum of initial and annual allowances cannot exceed the initial value of the asset.

6: Our Formula and Some Conclusions

We have set out in the Appendix the exact formula which we propose for the cost of capital, and some numerical calculations are presented in table 2. Even within this formula, there is room for a wide discrepancy between the actual numbers computed. This is because we have no hard and fast figures on the real rate of interest or the life of assets. The real rate of interest here is the difference between the expected rate of interest and the expected rate of inflation. For fixed interest borrowing over a long maturity, the expected rate of interest is known, but even in this case the expected rate of inflation is not at all

clear. It is often said that real interest rates were negative in the mid-to-late 1970s, but this is generally based on short-term evaluations as well as on realised inflation rates. Looking at a longer-term horizon for borrowing can alter the picture. For instance, borrowing in mid-1975, the year of highest inflation (and lowest real interest rates on some reckonings), for an eight year maturity at 12½ per cent. – which is roughly what eight-year gilts were yielding then – would have resulted in a positive *ex post* real interest rate (using the wholesale price index). There is some reason to believe that (expected) real interest rates are not volatile. Considering that their measurement remains uncertain and

Table 2: *Cost of Capital in Ireland, Illustrative Cases, Various Years (per cent. per annum)*

	MACHINERY AND EQUIPMENT				
Year	Non-Grant Aided Full Tax	Grant-Aided New Industry Full Tax	Grant-Aided New Industry Export-Oriented	Grant-Aided New Industry Full Tax Short Asset Life	Grant-Aided Small Industry Full Tax
1971	3.6	1.7	4.6	3.9	0.6
1972	3.6	1.7	4.6	3.7	1.2
1973	3.4	1.8	4.7	4.0	1.3
1974	3.3	1.9	4.8	4.0	1.2
1975	3.2	1.5	4.5	3.2	0.5
1976	3.3	0.9	3.9	2.0	0.5
1977	3.6	2.3	4.9	4.9	0.6
1978	3.7	1.3	3.9	2.6	1.5
1979	3.5	0.9	3.6	1.8	1.5
1980	3.5	1.4	4.1	2.9	1.3
1981	3.5	1.6	4.3	3.3	1.4
1982	3.2	1.1	4.1	2.5	1.3

Notes: Full Tax means firms paying full rate of Corporation (Profits) Tax at the margin. Grant Rate is the average rate of grant paid during the year. Export-Oriented means firms paying zero rate of tax at the margin. Short Asset Life: 10 years.

controversial, there is something to be said for taking the real interest rate to be a constant small positive percentage. We have chosen two per cent. for the figures in table 2. For the life of assets, we have chosen in most cases 20 years for machinery and 40 years for buildings. Machinery life may well be much lower – perhaps 10 years, and this would substantially increase the cost of capital. Our use of the longer life serves to show that one need not assume high depreciation rates to avoid getting negative cost of capital data.

Our calculations reveal the empirical features of the cost of capital in Ireland, some of which are evident from table 2.

– The net effect of tax and grant policies is to lessen significantly the cost of capital. At a typical set of rates[5] the cost of capital is 1.0 per cent., while it would be 7.0 per cent. at zero tax and grant rates.

– The cost of capital is sensitive to the rate of inflation. Typically an increase in the rate of inflation tends to lower the cost of capital, even if there is no change in the real rate of interest. For typical values this effect is quite significant: a ten percentage point change in the rate of inflation reduces the cost of capital by two percentage points. This anomaly arises because the tax system treats nominal interest payments as if they were real interest payments.

– The cost of capital in Ireland is rather small and, in practice, is inversely related to the tax rate. Year-to-year fluctuations in the cost of capital are small.

– While the theoretical possibility exists that an increase in the grant rate could increase the cost of capital, this does not happen for empirically relevant values of the parameters in Ireland.

– Although we have assumed a positive real interest rate there can still be negative values for the cost of capital so long as the depreciation rate is not too high.

APPENDIX

In order to make our computations explicit, it is desirable to express them in algebraic notation. Thus, let θ be the allowable initial-depreciation allowance, γ the proportion of (nominal) interest payments allowable against tax, τ is the rate of corporate income tax (Corporation Tax or Corporation Profits Tax) and r the real rate of interest. π represents the difference between nominal and real rates of interest, ϕ the capital grant rate, T the life of asset, D the true economic depreciation charge, and δ the tax depreciation rate.

In order to finance the use of one unit of capital, the amount to be borrowed will be reduced by grants and the initial depreciation allowance. We denote the amount so reduced by,

$$\Phi = 1 - \theta\tau - \phi, \tag{1}$$

in the case of machinery and equipment. This is because in Ireland both the grant and the initial depreciation allowance are expressed as a percentage of the gross price of the capital good.

In the case of buildings, the term is

$$\phi = (1-\theta\tau)\,(1-\phi), \tag{1'}$$

since the initial allowance can only be claimed on expenditure which has not been financed, either directly or indirectly, by the State.[6] There is a tax saving, or "shield" related to depreciation which is equal to the tax rate times a fixed nominal sum per unit of capital over a period of years defined by $(1-\theta)/\delta$. (No deduction is made for grant since depreciation is on the gross of grant cost.) Wherever we see a fixed nominal sum to be paid over a number of years T_o, we must convert it into a fixed real sum to be paid over the life T of the asset in order to obtain

the true annual equivalent to be included in the cost of capital. This involves using the expression for the present value of a constant stream of one unit for years discounted at (a continuous rate) α, i.e.,

$$S(\alpha,\beta) = (1 - e^{\alpha\beta})/\alpha \tag{2}$$

For example, S(0.1, 20) = 8.6, S(0.02, 20) – 16.5, S(α, 0) = 0 and S(0, T) = T. The fixed real sum corresponding to the tax shield on depreciation is then obtained by applying factor λ_1:

$$\lambda_1 = S(R + \pi, (1 - \theta)/S(r, T). \tag{3}$$

For π = 0.1, r = 0.02, θ = 0, δ = 0.05, T = 20, we obtain λ_1 = 0.46. There is also a tax shield on the whole of the nominal interest payments, in nominal terms annually, of

$$\gamma(r + \pi)\tau\phi.$$

Once more, this should be brought to an equivalent fixed real sum, in this case by applying the factor

$$\lambda_2 = s(r + \pi, T)/S(r, T) \tag{4}$$

if there is no initial allowance, $\lambda_1 = \lambda_2$.

As explained in section 5 the true depreciation charge D is a constant real quantity over the life of the asset with present value equal to the (net) cost of the asset, and the expression for this is

$$D = -S(-r, T). \tag{5}$$

It is conventional in finance theory, but not in the Irish cost of capital literature, to discount the tax shields by an amount depending on the extra leverage involved in obtaining them. For a target debt/equity ratio of unity, for example, tax shields could be reduced by one half of their value multiplied by the amount of debt incurred to obtain them. Thus, if ℓ is the ratio of debt/to debt-plus equity then the tax shields arising out of fixed interest financing, evaluated above should be premultiplied by

$$\lambda_3 = 1 - \ell\Phi. \tag{6}$$

Bringing the various terms together our expression for the after tax cost of capital is

$$r\Phi + D - \tau(\lambda_1\delta + \lambda_2\lambda_3 (r + \pi)\gamma\Phi) \ . \tag{7}$$

In our calculations we assume γ = 1, i.e., full deductibility of interest payments. In competitive equilibrium, the expression (7) will be equated to the *ex ante after tax* marginal product of one unit of capital. By convention, the cost of capital is expressed in units which equate it to the before tax marginal product of capital. Thus in our calculations we divide (7) by (1 – τ). Note that this cost of capital has the dimension of the reciprocal of time: it is a percentage. Some authors (e.g., GM) use the alternative convention of premultiplying an expression such as (7) by the price index of investment goods. So long as one bears in mind just what definition is being used there is no contradiction involved here.

Some features of equation (6) may be noted. First, an increase in the inflation rate lowers the cost of capital through the final tax shield term; and while there is an offsetting increase throughout the annuitising factors, these would not typically be large enough to reverse the overall effect. Second, the effect of an increase in the tax rate is in principle ambiguous. On the one hand it increases the value of the tax shields; on the other it lowers the after-tax return on the capital relative to the before tax return. As indicated in section 6 the first effect seems to dominate in practice. Third, the effect of an increase in the rate of grant is also ambiguous, even if the real interest rate r is positive. On the one hand, by reducing the amount of finance required Φ, it lowers the real interest charges, but on the other hand it reduces the value of the interest component – the tax shield. The possibility that an increase in grant might increase the cost of capital thus arises even when we recognise that the initial and depreciation allowances θ and δ are based on the gross investment. This case therefore supplements those discussed by Ruane (1982). Since the original version of this article was circulated, its main conclusions have been adopted by such authors as Ruane and John (1983) and Fitzgerald (1983). Only minor points of difference now remain between the formulas in current use.

NOTES

1. The possibility of real capital gains could also be taken into account if it were considered significant.
2. The delay in receipt of some of these benefits, e.g., the tax saving, might lead to additional short-term financing, but we ignore this detail.
3. A more complete list is in Flynn and Honohan (1982).
4. Of course, if we make this distinction, we must recognise that evaluation of the profitability of the investment should be carried out in real terms.
5. Those used in the Appendix.
6. We are grateful to John Fitzgerald for pointing out an error in our earlier paper on this point.

REFERENCES

FitzGerald, J.D., "Comments on Paper on the Cost of Capital in Ireland by Flynn and Honohan". *Paper read at the IAUTE Annual Conference*, Renvyle, April 1983.

Flynn, J. and P. Honohan, "Notes on the Cost of Capital in Ireland", *Central Bank of Ireland Technical Paper 6/RT/82*, 1982.

Geary, P.T., B.M. Walsh and J. Copeland, "The Cost of Capital to Irish Industry", *Economic and Social Review*, 1975, Vol. 6, pp. 299-311.

Geary, P.T. and E. McDonnell, "The Cost of Capital to Irish Industry: Revised Estimates", *Economic and Social Review*, 1979, Vol. 10, pp. 289-300.

Irvine, I., *Statistical Examination of New House Prices in Ireland in the Nineteen Seventies*, ESRI, (mimeo), 1982.

Kirwan, F.X., "Non-Wage Costs, Employment and Hours of Work in Irish Manufacturing Industry", *Economic and Social Review*, 1979, Vol. 10, pp. 231-254.

Ruane, F.P., "Corporate Income Tax, Investment Grants and the Cost of Capital", *Journal of Public Economics*, 1982, Vol. 17, pp. 103-110.

Ruane, F.P. and A. John, *Government Intervention, Debt Finance and the Cost of Capital to Irish Manufacturing Industry*, TCD, mimeo. 1983.

Stewart, J.C., "Fiscal Incentives and Company Financial Behaviour", *Journal of Irish Business and Administrative Research*, 1982, Vol. 4, No. 2, pp. 72-86.

Vaughan, R.N., *Measures of the Capital Stock in the Irish Manufacturing Sector, 1945-1973*, ESRI, 1980, Paper No. 103.