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CORPORATE FINANCIAL BEHAVIOUR IN THE PRESENCE OF TAXES.

CHRIS HIGSON

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CORPORATE FINANCIAL BEHAVIOUR IN THE PRESENCE OF TAXES

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NOTATION USED IN THIS STUDY

τ_t^*	effective corporate tax rate
$\tau_{c,t}$	statutory corporate tax rate
τ_b^i	personal tax rate on bond income
τ_d^i	personal tax rate on dividend income
τ_z^i	personal tax rate on capital gains
τ_m	imputation tax credit
r	pretax interest rate on bonds
φ_t	tax rules for period t earnings
δ_t	tax depreciation (capital allowances) rate
p	tax resumption lag
q	ACT resumption lag
s	statutory tax payment lag
X_t	taxable profit, before loss relief
L_t	losses carried–forward at t
$X_{O,t}^!$	operating profit, gross of depreciation, plus other income
I_t	investment in plant and in buildings
S_t	inventories
R_t	interest paid and received
E_t	equity
B_t	borrowing, net of cash and interest–bearing deposits
C_t	net trade credit given
T_t	corporation tax payments (mainstream + ACT)
K_t	stock of operating assets
N_t	equity issued during period t
M_t	surplus gross dividends carried forward

L_t tax losses carried forward

Y_t sales of tax losses at t

V_t firm's value at t,

c_d dividend yield

c_b upper bound on the firm's borrowing ratio,

c_l upper bound on tax loss sales

ρ pretax return from retained earnings

ρ' pretax return from dividends,

θ after basic rate personal tax discrimination variable,

λ_t lagrangean multipliers

Ω_t marginal value of a unit of dividend delivered in period t

$\pi_{c,t}$ probability of the firm being non–taxpaying in period t

$\pi_{m,t}$ probability of the firm having surplus imputation credits in period t

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CHAPTER 1

INTRODUCTION

This study measures the effective corporate tax rates faced by UK firms in the late 1970's and early 1980's and uses these rates to test for tax–driven corporate financial behaviour.

If firms adjust their financial behaviour in response to tax incentives, the UK of the 1970's and 1980's should be a good place to observe it. The UK has an imputation system of corporation tax in which firms can deduct interest payments at the corporate tax rate and dividends at the basic rate of personal tax. Prior to 1984 the corporate rate had been 52% while the basic personal rate had varied between 30% to 35%, giving a tax rate advantage to borrowing for a fully–taxed, full–payout firm of around 20%. Immediately after the Lawson tax reform of 1984 this 'wedge' narrowed to 5%. There was a spate of equity issues in the UK after 1984 which some commentators attributed to the shift in incentives. Moreover, at any statutory tax rate there was considerable cross–sectional diversity in the effective tax rates faced by UK firms. Low profitability and immediate write–offs for plant and for inventories generated widespread tax losses amongst UK firms in the late seventies and early eighties. Opportunities to arbitrage these tax losses, for instance by writing leasing contracts, were limited in supply. As a result some firms became 'tax exhausted' for lengthy periods and had a much reduced expected value for corporation tax deductions. A larger group had surplus dividend tax credits so were facing a classical tax system at the margin.

Despite the centrality of taxes in the theory of corporate financing, to date a large

empirical literature has produced inconclusive or perverse evidence on the relationship between taxes and corporate behaviour. This empirical failure to establish a tax effect may reflect the quality of the proxies researchers have used for interest tax shields. In this study a detailed model of the corporation tax system is built and used to estimate a firm's tax history and thus its stock of tax losses at each date, and to forecast the future evolution of its tax liabilities. The implied effective tax rates are used to test for tax effects on behaviour.

Chapter 2 provides the theoretical background to the study. The chapter analyses company financial behaviour under imputation and classical tax systems when firms have heterogeneous effective tax rates because of tax exhaustion. An expression is derived for the effective corporate tax rate under tax exhaustion in the context of a multiperiod partial equilibrium model of financial decisions. The main 'classical' results in the literature are shown as special cases of the general results and the elements of an empirical model of corporate borrowing behaviour are identified. The analysis emphasises the sensitivity of the equilibria to the implicit assumptions of 'dividend residual' valuation models, and emphasises the role of frictions and constraints on tax arbitrage in deriving equilibria consistent with the observed phenomenon of endemic tax exhausation in one section of the corporate population.

Chapter 3 describes the operation of the UK corporate tax system in more detail. Defining the effective corporate tax rate of a company at time t, $\tau^{*}_{t,}$ as (minus) the value at t of the incremental tax cash flows associated with a unit of positive taxable profit at time t, the effective corporate tax rate faced by a firm is shown to differ from the statutory rate because of lags in the tax system. One source of tax lag has displayed wide cross–sectional variation in the UK. Tax systems are assymetric in that tax losses do not generate instantaneous repayments of tax but can be carried forward, so a company with

tax losses may be non–taxpaying for several periods before 'tax resumption' when it can recover the tax on marginal taxable cash flows. In an imputation system there is an additional level of non–taxpaying: there are limits on the company's ability to relieve tax credits on dividends, and companies may develop stocks of unrelieved imputation credits. These must be carried to other periods so that, in a parallel fashion, the tax credit on the marginal dividend payment will only be recovered when the stock of unrelieved ACT is consumed. An expression is derived for the effective corporate tax rate in terms of its period of 'tax exhaustion' denoted 'p', and the duration of unrelieved imputation credits, denoted 'q'. This expression which is estimated empirically in subsequent chapters emerges from a description of the UK tax system, but is shown to be equivalent to the effective rate derived theoretically in Chapter 2 in the case of perfect foresight, and complementary to others which have appeared in the literature. Some of its properties are explored by numerical simulation.

Unfortunately forecasts of payment lags p and q are not in the public domain nor, indeed, are the underlying stocks of tax losses and surplus dividend tax credits. This is so even for past periods; though it is possible to observe the tax charge in past series of company accounts and observe the lag until tax resumption, other crucial tax numbers, notably the ACT liability for a period and the stocks of tax losses and of unrelieved ACT which the firm is carrying, are not disclosed. Moreover, even for past periods one may prefer modelled to actual outcomes as more appropriately replicating the data available for managerial decisions. Chapter 4 develops and tests a calibrated model of the UK corporation tax to generate company–level estimates of mainstream and advance corporation tax payments from the underlying economic data of the firm. A technical description of the model is provided and external validation is undertaken of certain aspects of model performance. Some of the difficulties of tax modelling using published accounts data are discussed, and an approach is adopted in which model estimates are

modified by published tax data to reduce estimation error.

Chapter 5 uses the corporation tax model to estimate effective corporate tax rates for UK companies. The chapter reports the incidence of tax exhaustion amongst UK industrial and commercial companies between 1973 and 1988. Estimates of tax resumption lags and effective corporate tax rates are provided at the company level. By 1980 over 40% of UK companies were not paying corporation tax, and more than 70% had surplus dividend tax credits. The implied median effective tax rate in the most tax exhausted industries was only half the statutory rate. Expected tax rates, conditional upon the future process in earnings and on the tax regime, are also estimated and point estimates are produced of the mean and variance of companies' effective tax rates.

Chapter 6 investigates the effect of the firm's effective tax rate on its borrowing decision. This chapter describes the borrowing behaviour of UK corporations between 1972 and 1988, and tests an empirical model of corporate leverage. In this model the firm's capital structure is a function of the effective tax rate it faces on interest and dividend payments, and of size, profitability, uniqueness, earnings volatility and asset structure. Theory predicts that, other things equal, firms with lower effective tax rates will borrow less, but to date a large empirical literature has produced inconclusive evidence on the relationship between taxes and corporate borrowing. The main findings of the chapter are as follows: The distinction between short and long term borrowing is empirically significant and there are distinct profiles for these two elements of corporate debt. Firms borrow long term when they are larger, less profitable in terms of return on assets, and when they have securable (=fixed) assets. Size is not a determinant of short term borrowing. Firms borrow short term when they have low return on assets and low margins, and when they have a low effective tax rate. Overall corporate debt levels mainly reflect size and (lack of) profitability, the latter consistent with Myers' 'pecking–order'. The

profitability/borrowing nexus is indeed so powerful as to reverse two predictions of conventional theory. Firms with higher business risk borrow more. Moreover the firm's effective tax rate is a good predictor of debt ratios, but with perverse sign. Non–taxpaying firms borrow more. The firm's effective tax rate, and to a lesser extent its business risk, are inversely correlated with profitability and apparently proxy financial condition. In this study R&D expenditure is a positive predictor of borrowing, counter to the predictions of 'uniqueness' theory. A picture of the relationship between asset structure emerges in which firms are able to borrow long term when they have fixed asset backing, and are less likely to borrow against market equity but are able to leverage growth opportunities in the associate with R&D expenditure. Debt ratios measured on market equity add nothing to those based on book, empirically.

Chapter 7 investigates the impact of tax and other factors on the financing of mergers and acquisitions. During the UK merger wave of the mid 1980s there was a significant increase in the proportion of equity financed bids. A common explanation at the time was the beneficial accounting treatment available after an equity bid, though these benefits appear to have been largely cosmetic. The chapter tests the accounting explanation against other hypotheses on the determinants of the consideration in takeovers during the decade to 1987. We find that accounting rules and the 'timing' factors of recent returns on the bidder's stock and conditions in the equity market were significant determinants of the consideration issued by bidders. Moreover cash was more likely to be used when bidders were liquid. Neither the hostility of the bid nor capital gains taxes were significant in explaining the consideration issued by bidders.

CHAPTER 2

A MODEL OF CORPORATE FINANCIAL DECISIONS WHEN THERE IS TAX EXHAUSTION

This chapter analyses company financial behaviour under imputation and classical tax systems, when firms have heterogeneous effective tax rates because of tax exhaustion. An expression is derived for the effective corporate tax rate under tax exhaustion in the context of a multiperiod partial equilibrium model of financial decisions. The main classical results in the literature are shown as special cases of the general results and the elements of an empirical model of corporate borrowing behaviour are identified. The analysis emphasises the sensitivity of the equilibria to the implicit assumptions of 'dividend residual' valuation models, and emphasises the role of frictions and constraints on tax arbitrage in deriving equilibria consistent with the observed phenomenon of endemic tax exhaustion in one section of the corporate population.

1 INTRODUCTION

Equilibrium was achieved in earlier models of the effects of corporate taxes on financial behaviour (Miller(1977), Modigliani and Miller(1963) 'MM') by employing aggregate constraints to limit the behaviour of actors. However the more recent tax–based financial policy literature has sought to demonstrate the feasibility of internal equilibria without the need for external constraints but achieved by non–linearity in the effective tax rate at the level of the firm. In DeAngelo and Masulis(1980a) the value of tax deductions on debt interest is progressively mitigated by tax exhaustion, so that at some level of tax exhaustion the corporate tax advantage to borrowing is balanced by the personal tax advantage to equity. Tax exhaustion also arises when a firm has surplus dividend tax credits in an imputation system and Mayer(1986) extends the DeAngelo & Masulis approach to generate equilibria on both the dividend/new issue and borrowing/new issue margins. In a similar spirit, this chapter analyses the incentives for corporate financial

behaviour provided by an imputation tax system when firms have heterogeneous tax positions because of tax exhaustion. The paper uses a dynamic programming approach to find the firm's financial policy which maximises the expected value of the dividend flow to shareholders[1].

Both the classical results of MM and Miller, and the equilibria of DeAngelo and Masulis and Mayer are derived within the model developed in this paper. However, it is also argued that without frictions we cannot explain the observed fact of persistent tax exhaustion in the corporate population. Without frictions, firms would simply resort to tax arbitrage until all the tax losses were consumed.[2] The need for frictions in deriving an equilibrium is emphasised – one market in tax capacity, freely operating, is sufficient to ensure effective corporate tax rates are equalised across firms. The kinds of frictions which are relevant here include the costs of arbitrage, supply constraints on lease contracts, and uncertainty. Rather than assume the existence of an equilibrium, this chapter uses the results of the model to display the direction of tax incentives on corporate behaviour in a world where firms may well behave as though there are constraints on financial behaviour.

The equilibria which emerge from these models are rather sensitive to their often implicit assumptions, and one aspect of this is explored in this paper. In the model described below, as is conventional in such models, dividends are the residual in the funds identity. The model is thus a 'full–payout' model, so for instance by default the principal of a one–period loan is repaid from the next period's dividend. Another implication is that

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[1]This approach is now conventional in this literature(see, for instance, King(1986), Mayer1986), Keen and Schianterelli(1988)), and similar equilibria to the ones derived here have been provided for an imputation system by both Mayer and Keen and Schianterelli. The architecture of the model presented here broadly follows Mayer though the real side is not modelled and is held exogenous to concentrate on financing.

[2]Assuming tax capacity is in limited supply.

the lower bound on the effective tax rate is, in an imputation tax system, the rate of imputation. This conclusion follows directly from the assumption that the marginal unit of income is paid out in full. This, perhaps unlikely, implication of theory has been extremely influential and has found its way into government policy statements upon the rationale for the imputation system in the UK. The effect on the marginal conditions of relaxing the assumption that dividend is the residual in the funds equation is explored. It is suggested that if the firm behaves so as to maintain a minimum dividend payout ratio this constraint should be extended to new equity. Once the implicit dividend cost of new equity is recognised the tax case for substituting debt for equity, and dividends for new equity, is weakened in an imputation tax system. In other words if there is a dividend puzzle debt policy may be less of a puzzle.

In Section 2 a simple model of the firm's financial side is described. Section 3 derives the equilibrium effective tax rate within this model, which is a function of statutory tax rates but also of the expected resumption date for taxpaying and for the recovery of imputation credits. Section 4 explores the dividend/new issue margin, and Section 5 the borrowing/new issue margin. Some of the main existing equilibrium models in the literature are demonstrated as special cases of this model. The sensitivity of the equilibrium conditions to the implicit assumptions of the model is explored, and testible implications for financial policy are derived in terms of effective tax rates. Section 6 discusses the specification of the effective tax rate for estimation.

2 STRUCTURE OF THE MODEL

A model of the firm's financial behaviour is developed in which the firm has three financial instruments available: equity, debt, and a mechanism for buying and selling tax losses. At the beginning of each period it may adjust its portfolio of these three instruments in the face of an uncertain cash flow from an exogenously endowed bundle of real assets, so as to maximise the present value of the after–tax dividends received by shareholders.

The firm has an endowment of operating assets, K_t, which includes inventories and net trade receivables. It augments its capital stock each period by a net investment, I_t, and its assets generate an uncertain operating cash–flow, $\tilde{X}_{O,t}$. These real variables will be assumed exogenous in order to fix attention on financial policy. The firm in this model is a 'corporation', enjoying some legal and fiscal privileges which individuals and partnerships do not have: it can issue equity claims with limited liability as well as debt claims on its operating cash flow and enjoys a particular tax regime. Equity of N_t is issued in period t and dividends, D_t, are paid on this equity. Borrowing, B_t, is in the form of a one–period bond, and interest is paid at a constant rate r on last period's borrowing. The firm pays tax, $\tilde{T}_t$, with no lag on positive taxable earnings. It can sell or assign[3] the right to use Y_t of tax losses at a unit price of p; theproceeds of the sale are not taxable. There are no other costs associated with financial policy, though behaviour may be constrained in various ways.

2.1 Constraints

The overriding constraint on the firm is an annual sources and uses of funds identity:

$$D_t \equiv \tilde{X}_{O,t} - I_t + B_t - (1+r)B_{t-1} + N_t + pY_t - \tilde{T}_t \tag{1}$$

---

[3]This assignment occurs when, for example, the firm writes a leasing contract as a lessee. In this case pY_t can be interpreted as reducing the cost of new capital investment, I_t.

Since the firm cannot independently choose all of B, N, Y, and D, it chooses B, N, and Y each period to determine the dividend vector which maximises V_t, the firm's value at t, subject to any further constraints on the variables. The constraints described below should be seen as potential rather than actual and the effects of invoking them are explored later. They comprise a set of quantity constraints on actors' opportunities for trading claims and tax positions.[4]

Though the funds constraint is important in ensuring internal consistency in financial policy it has to be handled with some care, since by default it has implications about financing behaviour which may be unrealistic. Though it is the expected value of the dividend stream which enters the equity investor's utility function, it is not necessarily realistic to treat dividends as the 'residual' in the funds identity, and the marginal conditions will be affected thereby. The 'dividend residual' assumption tends to imply that, for instance, interest on debt is paid out of dividends, and debt principal is repaid out of dividend; that dividends absorb unanticipated shocks in operating earnings, which are fully distributed. Earlier papers, not always working within the framework of a funds constraint have not necessarily assumed interest is funded from dividends[5]. In reality, in the short term, firms appear to use borrowing rather than dividends to absorb unanticipated shocks in operating earnings, and the stickiness of dividends is well documented. However modelling this stickiness in terms of an absolute minimum dividend (for example Mayer(1986)) implies a zero marginal dividend on new equity. If the firm maintains last year's dividend payout, expressed as a yield, c_d, on last year's

---

[4]Alternatively, and commonly, restrictions such as these take the form of a cost function associated with each activity; 'adjustment costs' are typically invoked on the real side, 'agency costs' on the financial. Quantity restrictions are adequate for present purposes and can be seen as convenient limiting cases of convexity; their multipliers can be naturally associated with the first derivatives of a cost function.

[5]Though King(1977) does, other authors including Stapleton(1972), Haley and Schall(1979) and Fung and Theobold(1984) allow funding from another source. See also Brennan(1980).

value, V^*_{t-1}, and offers the same yield on new equity, then

(2) $\quad D_t \geq c_d(V^*_{t-1} + N_t)$

In practice managers may set their target dividends in terms of dividend per share, rather than yield. Dividend per share is not very tractable in the context of this model. However if share repurchase is also restricted, a constraint on yield gives a consistent lower bound if the true constraint were on dividend per share and value is nondecreasing. If the target payout is zero this constraint defaults to a nonnegativity constraint on dividends, reflecting the limited liability status of shareholders – calls on shareholders are not permitted. Share repurchase is now legal in the UK (since Companies Act 1981) but, as in the US, if it is used as a financing instrument rather than an instrument of corporate restructuring the Revenue will probably tax it as a distribution rather than capital gain (Finance Act 1985) thus removing the fiscal incentive. If share repurchase is prohibited,

(3) $\quad N_t \geq 0$

There may be an upper bound on the firm's borrowing ratio, expressed as a proportion, c_b, of the firm's capital stock, K_t,

(4) $\quad B_t \leq c_b.K_t$

Constraining debt on exogenous real capital rather than on V^*_t gains tractability, but there is in any case some support in the literature for a 'book' rather than 'market' concept of gearing (Myers(1977)). Debt need not be positive, so (4) permits firms to lend. In terms of realism, this is rather important in the specification of a dividend valuation model with an exogenous real side and a prohibition on share repurchase, since it permits firms to store surplus cash rather than increase dividends.

If there is a constraint on the sale of tax losses it is assumed to take the form of an upper

bound such that the firm can only sell losses as some proportion c_1 $(0<c_1<1)$ of its new real assets,

(5) $$Y_t \leq c_1.I_t$$

2.2 The tax regime

If financial markets are frictionless, other than in taxes, and are complete then investors cannot have different marginal tax rates in equilibrium – marginal tax rates will collapse to equality unless prevented from doing so by frictions or quantity restrictions on instruments. In markets for riskless assets such as government bonds, Schaefer (1982) emphasised the role of frictions, notably institutional limitations on short–selling, in bringing about equilibrium. In fact it is rather difficult to talk about behaviour in markets for corporate securities without at least implicitly invoking constraints or frictions. In the present model there are two groups of actors, firms and investors (=households), which suffer different institutional constraints on their ability to trade and the way in which the proceeds will be taxed. Given their endowments, and leaving aside differences in risk and expectations, each group's demand and supply schedule for a particular financial instrument will depend solely on taxes. These supply and demand schedules reflect not only the endowed tax positions of the group members but also constraints on their ability to arbitrage these tax positions intragroup, prior to intergroup trading. Consider an example on the demand (for corporate debt) side. When modelling the market for corporate debt the personal tax rates of investors usually enter by assumption. For instance they were assumed zero in a Modigliani and Miller(1958) world, and as zero for dividends and progressive for interest income in a Miller(1977) world. However Miller and Scholes(1978) show one set of mechanisms which, in principle, permit the complete washing of personal dividend and capital gains taxes under US tax rules. A similar mechanism for debt interest would again generate a Modigliani and Miller(1958) world. Miller (1977) argues that the effective personal tax rate on dividend

income will be zero (Miller and Scholes(1978)), and assumes that there is a tax exempt municipal bond[6]. Taggart (1980) and Auerbach and King(1983) show that Miller equilibrium breaks down if markets are incomplete or if investors can arbitrage their tax positions: in this case all investors hold debt and equity, and firms may not pursue the goal of value maximisation. So assumptions on tax rates in equilibrium models are joint assumptions on statutory tax rates and on institutional constraints on actors.

In this paper, investor i faces the following personal tax rates,assuming cross–sectionally constant dividend and capital gains rate,

τ_b^i on bond income; τ_d on dividend income; τ_z on capital gains

Interest on borrowing is assumed not to be tax deductible for investors so that if there are personal tax differentials they cannot be arbitraged by investor borrowing; investors can only trade with firms. However, purely as a modelling issue, limits on investor trading only need to be such as to ensure a sufficient ex post distribution of personal tax rates for an equilibrium, so rather than endowed rates these investor tax rates could equally be seen as equilibrium rates in a world where investors have limited opportunities to arbitrage their personal tax.

In the UK dividends and interest are taxed on an accruals basis, but capital gains are taxed on realisation. Hence although it may not be too unreasonable to assume bond and dividend income are taxed instantaneously, capital gains can be taxed with a considerable lag, so τ_z should be interpreted as an effective or 'accruals equivalent' capital gains rate, though it is not endogenous to our model.

Investors are risk–neutral, and have homogeneous expectations, so they will price debt and equity claims purely on the basis of tax differences to equalise after–tax returns.

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[6]Chen and Kim(1979) extend Miller(1977) to incorporate risky debt.

Given the pretax interest rate on bonds, r, the investor will require a pretax return from retained earnings, i.e. from capital gains, of ρ, where (ignoring superscripts),

$$\rho = r(1 - \tau_b)/(1 - \tau_z)$$

and a pretax return from dividends, ρ', of

$$\rho' = r(1 - \tau_b)/\theta$$

Here $\theta = (1 - \tau_d)/(1 - \tau_m)$ in an imputation system where dividends are declared net of imputation tax credit, τ_m. This defaults to $\theta = (1 - \tau_d)$ in a classical tax system. θ is the after basic rate personal tax version of King's tax discrimination variable, that is, the additional dividend received if one unit of post–corporate–tax earnings is distributed (see King(1977) ch3, or King and Fullerton(1984) ch1, for a development of these concepts). It is assumed r, and the τ, are constant through time. The statutory corporate tax rate, τ_c, is assumed constant cross–sectionally, and all the statutory tax rate are assumed constant through time. The taxable earnings of the firm in year t are

$$\tilde{X}_t = \tilde{X}_{O,t} - rB_{t-1} + Y_t - \delta_t \tag{6}$$

where δ_t is tax depreciation ('capital allowances') and is a function of K_t, I_t, and the prevailing tax rules, all of which are exogenous. Under the imputation tax system the firm pays the proportion $\tau_m/(1-\tau_m)$ of dividend distributions to the Revenue authorities and can use this 'imputation tax' as a credit against corporation tax. The UK operates partial imputation and τ_m is set at the basic rate of income tax. Under a so–called 'full imputation' tax system $\tau_m = \tau_c$; while a classical tax system is at the lower bound, where $\tau_m = 0$.

The tax regime is assymetric so that the Revenue does not pay tax on negative taxable earnings but permits tax losses to be carried forward and set against future taxable earnings. Similarly there is an upper limit on the use of imputation tax credits; in the

UK only imputation against a 'full distribution' (gross of tax credit) of taxable earnings is permitted, but tax rules permit carryforward of unrelieved imputation credits. Consistent with UK tax rules, indefinite carryforward of tax losses and unrelieved imputation credits are assumed. On the other hand, for convenience, no carryback to earlier periods is permitted in this model in both cases.[7] Denoting total tax payments, T_t, tax losses carried forward from period t, L_t, and surplus gross dividends carried forward from period t, M_t, the following system describes firm taxation:

$$\tilde{T}_t = \tau_c \, MAX\left[0 \, , \, \tilde{X}_t - L_{t-1}\right] + \tau_m \left[M_t - M_{t-1}\right] \tag{7}$$

$$L_t = MAX\left[0 \, , \, -(\tilde{X}_t - L_{t-1})\right] \tag{8}$$

$$M_t = MAX\left[D_t/(1-\tau_m) + M_{t-1} - MAX[0, \tilde{X}_t - L_{t-1}] \, , \, 0\right] \tag{9}$$

2.3 The objective function

The objective of the firm is to deliver the vector of after–tax dividends with the highest present value to shareholders. The problem is thus to find $V_t^* = MAX[V_t \mid B_t, N_t, Y_t]$. We are assuming that investors are risk neutral. Equilibrium in the capital market requires that investors receive the same expected return in the form of dividends and capital gains through holding the stock as they would by selling and investing in the riskless asset, so:

$$r(1-\tau_b)V_t = \theta.\tilde{D}_t + (1-\tau_z)[\tilde{V}_{t+1} - V_t - N_t] \tag{10}$$

The assumption of risk–neutrality excludes issues of intertemporal risk–sharing. However, though the capital stock is assumed exogenous, the tax relief on interest, and tax–loss carryforwards still link successive periods and prevent the solution of V_t^* as a series of single period optimisations. This class of problem can be handled by invoking dynamic programming.

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[7]This omission is particularily significant in the case of imputation credits for which six years carryback is currently available in the UK. In the theoretical model the omission simply adds tractibility. In the empirical analysis the full carry–back regime is assumed.

Using (10) and (1),

$$(11) \qquad V^*_t = MAX(B_t,N_t,Y_t)\left[\tilde{D}_t.\theta/(1-\tau_z)-N_t+ V^*_{t+1}\right](1+\rho)^{-1}$$

where, from (1) and (7),

$$D_t=\tilde{X}_{O,t}-I_t+B_t-(1+r)B_{t-1}+N_t+pY_t-\tau_c MAX\left[0,\tilde{X}_t-L_{t-1}\right]+\tau_m\left[M_t-M_{t-1}\right]$$

and from (6),

$$\tilde{X}_t = \tilde{X}_{O,t} - rB_{t-1} + Y_t - \delta_t$$

subject to the constraints (associated multipliers are in brackets)

$$(12) \quad (\lambda^d_t) \qquad D_t \geq c_d(V^*_{t-1} + N_t)$$

$$(13) \quad (\lambda^n_t) \qquad N_t \geq 0$$

$$(14) \quad (\lambda^b_t) \qquad B_t \leq c_b.K_t$$

$$(15) \quad (\lambda^y_t) \qquad Y_t \leq c_l.I_t$$

and the state equations

$$(8) \quad (\lambda^l_t) \qquad L_t = MAX[0\ ,-(\tilde{X}_t-L_{t-1})]$$

$$(9) \quad (\lambda^m_t) \qquad M_t = MAX\left[D_t/(1-\tau_m) + M_{t-1}- MAX[0,\tilde{X}_t-L_{t-1}]\ ,\ 0\right]$$

The Lagrangean is described in full in Appendix A.

2.4 The cost of retentions

It is convenient initially to derive the value to the shareholder of a marginal unit available for dividend,

$$(16) \qquad \Omega_t = \delta V^*/\delta D_t = \theta/(1-\tau_z) + \lambda^d_t$$

Ω_t is the marginal value of a unit of dividend delivered in period t, loosely, the factor which converts an incremental cash flow to the firm into an incremental cash flow to shareholders. Hence Ω can be interpreted as the marginal cost of retentions or dividend foregone.

3 THE EFFECTIVE CORPORATE TAX RATE

Let $\pi_{c,t}$ and $\pi_{m,t}$ be the probabilities of the firm being non–taxpaying in period t and of having surplus imputation credits in period t respectively, that is:

$$\pi_{c,t} = \int_{\infty}^{\mu_c} \epsilon(X_{O,t}).dX_{O,t} \text{ , where } \mu_c = rB_{t-1} - Y_t + \delta_t + L_{t-1} \tag{17}$$

$$\pi_{m,t} = \int_{\infty}^{\mu_m} \epsilon(X_{O,t}).dX_{O,t} \text{ , where } \mu_m = \mu_c + (D_t/(1-\tau_m) + M_{t-1}) \tag{18}$$

The effective corporate tax rate, τ_t^*, is the tax effect on the firm of a marginal unit of taxable profit, X_t.

$$\tau^* = \delta T_t / \delta X_t \tag{19}$$

$$= (1-\pi_{c,t})\tau_c + \pi_{c,t}.\lambda_t^l/\Omega_t + \pi_{m,t}(1-\pi_{c,t})\lambda_t^m/\Omega_t + \pi_{m,t}.\tau_m$$

Here, division by Ω_t defines λ_t^l/Ω_t and λ_t^m/Ω_t as the marginal value of a unit of tax loss carryforward, and unrelieved imputation credit carried–forward, respectively, undistributed by the firm. Expression (19) has the following solutions for corner values of π (assuming π has this value in all periods):

$\pi_c=0, \pi_m=0$	τ_c
$\pi_c=0, \pi_m=1$	$\tau_c+\tau_m$
$\pi_c=1, \pi_m=1$	τ_m

$\pi_c=1, \pi_m=0$ is infeasible in a world with no carryback of tax losses or unless the firm has surplus dividends received (see below)

3.1 The effective tax rate in a classical system.

The intuition behind τ^* can be developed by considering the relatively simple world of the classical tax system. First it is necessary to establish the shadow price on tax losses. This is:

(20) $$\lambda_t^1 = [\Omega_{t+1}\pi_{c,t+1}\tau_c+(1-\pi_{c,t+1})\lambda_{t+1}^1](1+\rho)^{-1}$$

which, using (19), $$= (\Omega_{t+1}\tau_{t+1}^*)(1+\rho)^{-1}$$

Recalling that τ_c is assumed constant through time, and if n is the horizon over which the firm is sure to be taxpaying where $\pi'_{c,t}$ is the probability of first paying tax in some period, such that $\sum_{s=0}^{n}[\pi'_{c,t+s}] = 1$

(21) $$\tau^* = \tau_c . \sum_{s=0}^{n}[(1-\pi'_{c,t+s})\Omega_{t+s}/\Omega_t](1+\rho)^{-s}$$

The effective tax rate is the corporate rate, τ_c, times the probability of first paying tax in each future period, times the personal tax–premium associated with paying dividends in that future period, (Ω_{t+s}/Ω_t) at a present value $(1+\rho)^{-s}$. If personal taxes are constant and the shadow price on the dividend constraint, λ_t^d, is either zero, or by chance constant, then this tax–premium is zero, and

(22) $$\tau^* = \tau_c . \Pi_t$$

where $\Pi_t = \sum_{s=0}^{n}[\pi_{t+s}.(1+\rho)^{-s}]$ is the firm's discounted probability density function for tax exhaustion.

3.2 The effective tax rate in an imputation system.

In a similar manner, the shadow price on unrelieved imputation credits is[8]

(23) $$\lambda_t^m = -\frac{[\Omega_t - \Omega_{t+1}/1+\rho]\tau_m(1-\tau_m)}{1-\tau_m(1-\pi_{m,t})} + \frac{\lambda_{t+1}^m[\pi_{m,t+1}/1+\rho]}{1-\tau_m(1-\pi_{m,t})}$$

Assume first that the firm is tax–paying but has unrelieved imputation credits for one period with probability 1, then from (19)

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[8]For the derivation see Appendix 2.

$$\tau_t^* = \tau_c + \lambda_t^m/\Omega_t$$

and from (23), assuming $\pi_{m,t+1} = 0$,

$$\lambda_t^m/\Omega_t = -\tau_m(1-\tau_m)[1-\Omega_{t+1}/\Omega_t(1+\rho)]$$

or **holding dividends constant**,

(23a) $$\lambda_t^m/\Omega_t = -\tau_m[1-\Omega_{t+1}/\Omega_t(1+\rho)]$$

Here the effect of a unit increase in taxable earnings is to bring forward the recovery of τ_m of imputation credits which would otherwise have been recovered one period later at a present value of $\tau_m/1+\rho$. The value of this early recovery is also a function of the relative value of a unit of dividend now and in one period, Ω_{t+1}/Ω_t.

In summary, the effective corporate tax rate (19) has four elements in an imputation system. The first and second elements on the RHS contain the classical components of the rate, which are a function of the statutory corporate tax rate and the probability of tax exhaustion. The third element measures the effect of an increment of taxable profit in accelerating the recovery of unrelieved ACT credits, and the final term captures the tax penalty paid by the tax exhausted firm if it pays the increment of taxable profit out as dividend.

The final term suggests that in an imputation system the rate of imputation, τ_m, places a lower bound on the effective tax rate. This, perhaps surprising, implication of the theory has been extremely influential and has found its way into UK government policy statements upon the rationale for the imputation system in the UK. However it is clear from the previous discussion and from the structure of (19) that this implication will hold only if both

– the full–payout assumption of the dividend valuation model holds, and

– if tax exhaustion dominates ACT exhaustion in the sense that the firm is sure to be

ACT exhausted if it is tax exhausted. Comparison of (18) with (17) suggests that this dominance will be hold so long as D (net dividends paid) and M (surplus ACT brought forward) are both non–negative. But in practice both may be negative. Colin Mayer has pointed out in conversation that the firm may have a surplus of dividends received over dividends paid ('surplus franked investment income' or f.i.i.). In this case D is negative and the firm can absorb the ACT on an increment of dividend paid even when it is tax exhausted. Casual empiricism suggests that very few firms have surplus f.i.i.. But a similar effect is created when the firm is first tax exhausted because the carryback period for surplus ACT has always exceeded that for tax losses (before 1983, three years for ACT and one year for tax losses, from 1983 to 1992, six years and one year). In this case M may well be negative since the firm is effectively carrying forward ACT 'capacity' from earlier periods which permits it to shelter dividends even when it has tax losses. The assumed nonnegativity of M arose purely because, as in other published models, the present model assumes no carryback of tax losses or surplus ACT.

4 THE DIVIDEND/NEW ISSUE MARGIN

The results of the model are now applied to derive testable hypotheses on the effect of taxation on corporate financial behaviour under an imputation system of corporation tax. Two margins are considered, that between dividends and new issues of equity and, in the following section, that between borrowing and new issues of equity.

4.1 Cost of equity

In equilibrium:

$$(24) \qquad \delta V^{*}/\delta N_t = \Omega_t - [1 + c_d.\lambda_t^d + \lambda_t^n] + \lambda_t^m \pi_t^m/(1-\tau_m)] = 0$$

It will be convenient to denote the cost of new issue equity as $\xi_t = 1+c_d.\lambda_t^d-\lambda_t^n$. Hence the cost of new issue finance is increasing in the target dividend yield, c_d, when the dividend constraint is binding, and is decreasing in the probability of unrelieved imputation credits, π_t^m.

4.2 The effective imputation rate

As the following holds as an inequality the firm will adopt extreme positions: either it will issue equity and pay out all its profits as dividend, or it will pay no dividend:

$$(25) \qquad \Omega_t + \lambda_t^m \pi_t^m/1-\tau_m \gtreqless \xi_t$$

The necessary conditions for tax system neutrality emerge directly from (25).

Ignoring constraints (all $\lambda=0$) the system will give dividend neutrality when

$$(26) \qquad \Omega = 1, \text{ which is,}$$

in a classical system $\qquad (1-\tau_d)/(1-\tau_z)=1$

in an imputation system $\qquad (1-\tau_d)/(1-\tau_z)=(1-\tau_m)$

Neutrality occurs in a classical tax system when $\tau_d = \tau_z$, or if we assume in each case the

effective capital gains tax rate is zero (τ_z=0), for a zero–rate investor (τ_d=0), and in an imputation system for a basic rate investor (τ_d=τ_m). In reality this neutrality may be elusive in an imputation system since investors are likely to be tax exempt institutions or higher rate individuals. Consider the former group. Unconstrained and without limits on the utilisation of imputation credits the firm has a money machine. It will certainly pay sufficient dividend to generate a level of imputation credit which washes corporation tax out of the system but will go further and pay new–issue financed dividend to accrue tax refunds without limit. However the carry–forward provisions of the imputation system mean that there is some probability of ACT exhaustion. The firm will pay dividend until the expected value of tax credit equals the investor marginal tax rate. From (25), (23)

$$\begin{aligned}\tau_d &= \tau_m(1+\pi_t^m\lambda_t^m)\\ &= \tau_m^*, \text{ the effective imputation rate}\end{aligned}$$

The following scenario gives an indication of the feasibility of an internal equilibrium under (1990) UK tax rates: $\tau_m = .25$; assume an (effective) $\tau_z = .10$; then the equilibrium is feasible so long as $\tau_d \leq .325$. Since the top rate of income tax is 40% this equilibrium appears feasible. A financing pecking–order of the Myers sort (Myers(1984), Myers and Majluf(1984)) can arise in the framework of equation (25). If there is assymetric information the firm may pay a 'lemons–premium' for its outside equity (λ^n>0) introducing, in the absence of other costs and constraints, a step between the costs of retentions and new issue equity, and thus a preference for internally generated funds[9].

[9]The lemons notion is due to Akerlof(1970). A recent presentation and empirical test of the effect on equity financing is Fazzari, Hubbard and Petersen(1988).

5 THE BORROWING/NEW ISSUE MARGIN

5.1 The cost of borrowing

In equilibrium:

$$(27) \qquad \delta V^{*}/\delta B_t = \Omega_t - \Omega_{t+1}(1+r(1-\tau^{*}_{t+1}))(1+\rho)^{-1} - \lambda^{b}_{t} - \lambda^{m}_{t}\pi^{m}_{t}/(1-\tau_m) = 0$$

and the cost of borrowing is

$$(27a) \qquad \Omega_{t+1}+\Omega_{t+1}r(1-\tau^{*}_{t+1})(1+\rho)^{-1} - \lambda^{b}_{t}$$

The marginal cost of borrowing in this framework depends crucially on the assumptions made about financing the debt interest and refinancing the principal, as well as those assumptions built into the effective tax rate which were described earlier. Above, conventionally, it was assumed that the loan is replaced by drawing down dividend, By contrast if it were assumed that the interest is paid from dividend but that the principal is refinanced from new equity the cost of borrowing is

$$(27b) \qquad \xi_{t+1}+\Omega_{t+1}r(1-\tau^{*}_{t+1})(1+\rho)^{-1} - \lambda^{b}_{t}$$

5.2 Some classical borrowing eqilibria

In Modigliani and Miller's untaxed (1958) world corporate and personal taxes are equally zero and so equilibrium is indeterminate and financial policy irrelevant. By contrast in MM(1962), with positive corporate taxes but no personal taxes, there are unlimited gains to corporate borrowing in (28a), and aggregate supply and demand are only equated by the introduction of a friction in the form of an aggregate limitation on the supply of firms. This induced downturn in supply implies that the tax gains to borrowing accrue to firms as a suppliers' surplus.

Miller (1977) also assumes $\tau_c > \tau_d = \tau_z = 0$, but that individuals may differ in τ_b. Equilibrium will be determined by the marginal bondholder, m, for whom $\tau^{m}_{b} = \tau_c$.

A corollary of this is that investors form clienteles for corporate debt or equity as their individual tax rates are either below or above this rate. To ensure that the heterogeneous tax rates of investors generate a demand curve for corporate debt which intercepts the supply curve it is necessary to restrict the opportunities for investors to trade–away their tax differentials before entering the corporate debt market. It is necessary to assume investor short–selling is either prohibited or sufficiently limited to leave a suitable dispersion in τ_b ex post, namely that there is at least one investor i , in each of the three classes:

$$\begin{aligned} &\text{net demander} && (1-\tau_b^i) > (1-\tau_c) \\ &\text{indifference} && (1-\tau_b^i) = (1-\tau_c) \\ &\text{net supplier} && (1-\tau_b^i) < (1-\tau_c) \end{aligned} \tag{28}$$

MM closed their model by limiting the supply of debt in aggregate; Miller by having the aggregate demand curve turn up.

The contribution of DeAngelo and Masulis(1980a) was to recognise that financial equilibrium can be achieved by modelling a decreasing supply schedule for debt at the firm–level. Assume there is no market for tax losses. In DeAngelo and Masulis(1980a) firms may only borrow at the beginning of the period when they are still uncertain about period income, and so have some probability of tax exhaustion in the current period due to excess tax credits. Since their's is a one–period model the carry–forward of losses is precluded, and they also assume no market for selling taxable capacity, so $\lambda_t^1=0$. In such a world we can see from (15) that $\tau^* = \pi_t.\tau_c$. Maintaining Miller's other assumptions, they derive an equilibrium in which each firm has a unique optimum in which $\tau_b^m=\tau^*=\pi.\tau_c$, that is, each firm adjusts its gearing until its expected corporate tax rate equals the market–determined marginal personal tax rate. This result depends crucially on the firm's borrowing being unconstrained, so that borrowing is a sufficient instrument

for the attainment of equilibrium. The DeAngelo and Masulis internal equilibrium was clearly feasible with tax carryforwards. Indeed tax carryforward is not technically inconsistent with the firm which only endures for one period since it might sell its 'trade' and legally the tax loss can accompany the continuing trade. In general the supply function for debt has downward slope so long as: $\tau_c > \lambda_t^1/\Omega_t$. Miller was describing the limiting case where this relationship holds with equality. Testable implications of DeAngelo and Masulis (1980) include:

– Other things equal there will be an overall reduction in corporate borrowing as tax allowances increase over time

– Firms with lower tax credits will have higher debt–equity ratios.

– Conformity of tax allowances within an industry may explain, therefore, observed industry gearing ratios.

– Because the value of tax loss carry forwards falls in an inflationary environment gearing levels will rise.

Corcoran(1977) and Zwick(1977) report that in the US debt–equity ratios did indeed rise between the mid–1960's and the mid–1970's when inflation was also rising. Several writers have developed D&M's one–period approach. Talmor, Haugen and Barnea(1985) take the one–period assumption rather literally and show that D&M are making incompatible assumptions about wealth and income taxation. Under realistic tax codes they derive corner rather than interior solutions to the D&M problem. More interestingly, Park and Williams(1985) develop the same perception about differential taxation of principal and interest in a one period world to model an equilibrium with a diversity of discount/coupon bonds of different coupons and clienteles.

5.3. Equilibrium under imputation rules

In equilibrium the firm will equalise the marginal cost of debt and of new issues of equity.

From (24) and (27)

(29) $$\xi_t = (\Omega_{t+1}+\Omega_{t+1}r(1-\tau^*_{t+1}))(1+\rho)^{-1} - \lambda^b_t$$

As it stands this expression is not particularily tractable. However things are simplified dramatically by assuming the firm is in an unconstrained equilibrium on the dividend/new issue margin, so that from (25) $\xi = \Omega$. In this case (28) becomes

(28a) $$1+\rho = 1 + r(1-\tau^*_{t+1})$$

which is $$(1-\tau_b)/(1-\tau_z) = (1-\tau^*_{t+1})$$

This is the well–known 'knife–edge' condition where the firm, being indifferent between dividend and new issue finance, pays additional current dividend financed by borrowing so long as this policy has a positive present value. This present value is entirely a function of the tradeoff between corporate and personal tax rates.

However, in an imputation system the dividend/new issue and borrowing/new issue margins appear to sit together uncomfortably in an unconstrained equilibrium, since if we assume Ω=1, then from (26) and (28a) $\tau^*_c = \tau_m$. This result, which is derived by Keen and Schianterelli(1988), implies that if there is an equilibrium it will be one in which firms expect the effective corporate tax rate to be below the statutory rate.

Once the assumptions of the dividend residual model are relaxed a number of alternative equilibria present themselves. A scenario which may be more plausible than that described above is that, while the interest on debt is paid at the expense of dividend, the principal is replaced from new equity, then:

(30) $$\xi_t(1+\rho)=\xi_{t+1}+\Omega_{t+1}r(1-\tau^*_{t+1})$$

so, assuming constancy in the tax parameters

$$\rho\xi=\Omega r(1-\tau^*_{t+1})$$

$$\xi=(1-\tau^{*}_{t+1})/(1-\tau_{m})$$

Again the identity between the effective corporate rate and the imputation rate re–emerges. In Keen and Schianterelli τ_m puts a lower bound on τ^{*}_{c} but as noted earlier this may be confounded both if the full payout assumption of the dividend valuation model does not hold or if the firm has net dividend receipts or is bringing forward ACT capacity. Though these equilibria are apparently counter–factual they merit some discussion. One arbitrage, on the dividend/borrowing margin, is one in which the firm pays out a unit of dividend and borrows back one unit using a one period bond. The investor receives $(1-\tau_d) + r(1-\tau^{m}_{b})$ while the firm pays $(1-\tau^{*}_{m}) + r(1-\tau^{*}_{c})$. This has a positive NPV so long as $\tau_d + r\tau^{m}_{b} < \tau^{*}_{m} + r\tau^{*}_{c}$. This could alternatively be seen as the choice the investor makes between earning income in the incorporated and unincorporated sectors. In this case if the firm is paying an equilibrium dividend ($\tau_d=\tau^{*}_{m}$) then equilibrium borrowing occurs where $\tau^{m}_{b} = \tau^{*}_{c}$, which is a Miller equilibrium, while if, further, investors are taxed identically on dividend and bond income, $\tau^{*}_{m} = \tau^{*}_{c}$. In practice company law prevents most firms making the dividend payments necessary to acheive this equilibrium. Dividends are only legally paid from realised (accounting) profits and though taxable profits may be below accounting profits this arbitrage uses up distributable profits at the rate of 1/r of dividend per unit of taxable profit sheltered.

5.4 An empirical model of the borrowing decision

Since the model is linear, there is no need to assume the firm is in equilibrium in an unconstrained world to derive unambiguous testable hypotheses on the tax incentives to borrow. Expanding (29) we have

$$(31)\ \{1+r\frac{(1-\tau_d)}{(1-\tau_z)}\}(1+c_d.\lambda^{d}_{t}-\lambda^{n}_{t}) = \{\frac{(1-\tau_d)}{(1-\tau_m)(1-\tau_z)} + \lambda^{d}_{t}\}(1+r(1-\tau^{*}_{t+1})) - \lambda^{b}_{t}/(1+\rho)$$

τ_d and τ_z can be interpreted as the personal and capital gains tax rates of the marginal

investor. These are unobservable empirically, but the validity of the partial derivatives described below merely depends on the plausible assumption that equity clienteles do not adjust with equal and opposite effect.

In (31) the tax incentive to borrow is

1. increasing in the effective corporate tax rate, τ^* , thus:

   increasing in $\tau_{c,}$ decreasing in τ_m

   decreasing in the expected lags to tax resumption and of unrelieved imputation credits;

   increasing in the dividend payout ratio.

2. increasing in the interest rate, r, and if dividends are a constraint, increasing in the dividend payout ratio.

6 THE EFFECTIVE TAX RATE IN ESTIMATION

The effective tax rate to be measured empirically in this study is now described and its relationship to the effective tax rate which was derived earlier is discussed.

In the special case of deterministic tax paying where the firm knows it will resume taxpaying with certainty after **p** periods ($\pi'_{c,t}$ is 0 or 1 and is first 1 at time p) then from equation (22):

(22a) $$\tau^{*} = \tau_{c}.(1+\rho)^{-p}$$

Again for a deterministic case where the firm will have unrelieved imputation credits with certainty until tax resumption after **q** periods, from (23)

(23a) $$\lambda^{m}_{t}/\Omega_{t} = -\tau_{m}[1-\Omega_{t+1}/\Omega_{t}(1+\rho)^{-q}]$$

Assuming now constancy in Ω an empirical expression for the imputation effective tax rate can also be derived. Combining (22a) and (23a):

(32) $$\tau^{*} = \tau_{c}(1+\rho)^{-p} - \tau_{m}[(1+\rho)^{-p} - (1+\rho)^{-q}]$$

(32) is the metric of the firm's effective tax rate that is estimated in this study, and it is necessary both to assess its completeness and its relationship to the results derived earlier. Before doing so we examine the effect on the effective tax rate when the availability of markets in taxable capacity permits firms to arbitrage their tax positions.

6.1 The effective tax rate with markets for taxable capacity

The marginal value of tax loss sales is:

(33) $$\delta J/\delta Y_{t} = p - \lambda^{y}_{t} - \tau^{*}$$

Equation (33) says that in equilibrium the firm will equate its marginal revenue from tax loss sales with the effective tax rate. In equilibrium, using (19)

(34) $$p - \lambda^{y}_{t} = (1-\pi_{c,t})\tau_{c} + \pi_{c,t}.\lambda^{l}_{t}/\Omega_{t} + \pi_{m,t}(1-\pi_{c,t})\lambda^{m}_{t}/\Omega_{t}$$

The firm will achieve (34) through any activity which can alter the probability of non–taxpaying, π_c, or of unrelieved imputation credits, π_m. Taking real activities as exogenous, this means through borrowing or dividend policy or through the purchase or sale of tax capacity.

The firm with tax losses can use them to displace tax on its own earnings in future periods, but if markets exist it can displace them immediately by using the taxable earnings, or 'taxable capacity', of other firms. Consider a simple example of the operation of markets for taxable capacity in a classical tax system. Assume τ_c is .5 in all periods. Firm j has tax losses and expects to be tax exhausted until time T, and though an incremental \$1 of tax loss available today will save 50c of tax at T, the expected value of that 50c is, say, only 20c today. Hence $\tau_j^* = .2$. Firm j should be prepared to sell its losses for a price over 20c. Suppose firm k is in the reverse position: it is fully–taxpaying ($\tau_k^* = \tau_c = .5$) and would be prepared to pay up to 50c to avoid having \$1 of profit taxed.

Assuming there are no costs or frictions in the market for taxable losses, firms k and j have an incentive to trade taxable losses when they have tax capacity 'endowments' such that:

$$\tau_k^* > p > \tau_j^* \tag{35}$$

and they will trade until (35) holds with equality in a costless world. More realistically in a world with transactions costs, λ_t^y, tax rate differentials will persist and will be (lower) bounded by

$$\tau_k^* - \tau_j^* = \lambda_t^y \tag{35a}$$

Define X+, X– as the amounts of taxable capacity (+ve), or tax losses (–ve) with which firms are initially endowed, and X as the total of taxable capacity for the economy. Then the equilibrium will be:

(36)
$$p = t_k^* = t_j^* = \tau_c,\ X \geq 0$$
$$p = t_k^* = t_j^* < \tau_c,\ X < 0$$

This assumes that tax losses, X–, is the commodity being sold. One could just as well conduct the discussion in terms of a price, p', on taxable capacity, the price required in equilibrium to induce a firm to supply \$1 to be taxed at the full rate, and reinterpret the above results by noting that $p + p' = \tau_c$.

The foregoing argument transfers unchanged to an imputation system since similar relative tax positions can arise under imputation. Suppose that the facts are unchanged except that firms can impute dividends at 30%, $\tau_m = .3$ and the firm j effective tax rate is now generated by ACT exhaustion. Firm j is tax paying, $\pi_c = 0$, but permanently ACT exhausted, $\pi_m = 1$. From (23) $\lambda^m = \Omega_t \tau_m$, thus, from (19), $\tau_c - \tau_m = .5 - .3 = 20\%$. The intuition of this effective tax rate is that an incremental \$1 of taxable income is taxed at 50c but relaxes the constraint on imputation, enabling the firm to recover 30c of otherwise unrecoverable ACT. Hence the existence of unrelieved ACT offers opportunities for tax loss selling in a parallel fashion to the existence of non–taxpaying in a sector of the corporate population. Bearing in mind (35a) the size of the market for tax losses will be, in part, a function of τ_m which defines the maximum potential ACT–induced tax rate differential.

Tax loss selling is an abstract notion and is not permitted as such in any jurisdiction; the most proximate analogue is leasing, but any contract between firms with different effective tax rates which alters the profile of taxable cash flows has this effect. In the case of leasing the lessee effectively sells tax losses. Firms k and j would act as lessors and lessees respectively in the above case. Edwards and Mayer(1991) develop a full analysis of the leasing decision within a similar framework to the present study. They also model

the real investment decision but for tractability assume only mainstream tax exhaustion. In equilibrium they have

$$\tau_t^* = (r+\delta-R_{t+1})\rho/(r\alpha(1+\rho)) + (r-\rho)/r(1+\rho)$$

Here R_t is the lease rental rate. Comparison of this expression with (33) shows that the observable price, the lease rental rate (paid by the lessor) is a function of the underlying price for a unit of tax capacity (received by the lessor, in the present model), the borrowing rate and β, the economic rate of depreciation of the asset. The rate at which leasing can transfer taxable capacity is a function of the rate of initial tax allowances, α in this system, and of β. Only in the limiting case, such as the UK capital allowance system pre–1984, can leasing offer pound–for–pound tax loss selling (α=1, β=1).

Clearly in the presence of one market for taxable capacity freely operating all companies' tax rates collapse to a single rate and the cost of capital is determined at the aggregate rather than the firm level. Casual empiricism suggests that in reality firms remain persistent taxpayers or non–taxpayers to an extent which is inconsistent with freely operating markets for tax capacity or indeed with the sort of short–term excursions from equilibrium which might arise if there were 'installation lags' on the real asset side or if the firm's (stochastic) tax position were revealed too late to arbitrage within the same period. A number of real asset transactions is available which permit transfer of taxable capacity between firms. The most commonly cited real asset transactions are leasing and acquisition. In the case of acquisition firms with heterogeneous tax loss or surplus ACT positions are able to arbitrage them using the group relief rules. Purely financial transactions include debt and dividend policy. Cooper and Franks(1983) discuss the costs and restriction which may arise in practice and which may limit the full arbitrage of tax losses so that firms display heterogeneous tax rates. These costs include transactions and monitoring costs. In the case of lending, agency and moral hazard costs are likely to be

important, and lending may also affect the expected value of bancruptcy costs. By reducing the risk of existing debt it may expropriate value from equity thus partly offsetting the value of tax savings. Cooper and Franks produce a numerical example showing, under plausible tax and interest rate assumptions at that time, how quite low transactions costs of the order of 2% to 6% can shift the firm's idiosyncratic tax resumption date out from 1 to 4 years. Other restrictions in practice include Inland Revenue rules designed to limit tax arbitrage (some of these have been mentioned in the text above). One of these limits the supply of finance lease contracts to the supply of real assets. There appear to be no such limitations on borrowing.

6.2 The role of the effective corporate tax rate

The aim of this chapter is to derive the relationship between corporate financial policy and the effective corporate tax rate. It does so within the framework of a multiperiod model of the financial side of a firm seeking to maximise the present value of the stream of dividends which it delivers to shareholders.

There is no particular presumption in this paper that the firm is in equilibrium in a world without frictions or constraints on arbitrage. By way of comparison preceding sections have described some of the main unconstrained equilibria in the literature. Establishing the feasibility of such equilibria has been a major preoccupation of much existing work, though in most of these papers the authors do rule out, ab initio, tax arbitrage between individuals, or implicitly limit such arbitrage. If the firm is unconstrained the value of τ^* is determinate and we can solve for τ^* in terms of external tax and interest rate parameters. In Mayer(1986) as in DeAngelo and Masulis(1980a) the equilibrium is one in which there is diversity in effective tax rates across firms because of a 'friction' in the form of uncertainty about the outturn of taxable profits, which cannot be traded away instantaneously. Without such differences in expectations cross–sectional effective tax

rates would again converge through adjustment to a common set of external parameters. As we noted above another set of mechanisms which will tend to drive effective tax rates to the same level are contractual arrangements which allow firms to trade tax liability, such as leasing, and in the extreme case merger. Any of these markets, freely operating, would appear to be sufficient. The very real differences in effective tax rates found in practice are hard to reconcile with an absence of constraints or with short–term uncertainty about taxable income

Several points should be noted about the estimating version of the effective tax rate in (32). Whilst it captures the key elements of (19), note also that (32) omits the final term in (19), hence it assumes zero payout rather than the full payout of the 'dividend residual' model. As was noted above we may want to reject the notion of a minimum effective tax rate either on this ground or because the firm is effectively paying negative dividend or has negative carry forward of imputation credits. Though this specification probably accords with managers beliefs, more realistic still is to assume that some of the marginal income will be distributed at some point. However the model in this paper is partial in that the real side is exogenous. In a more complete model some of the incremental cash flow will be required for reinvestment and thus its realisation for the investor indefinately postponed. Moreover we know little about the marginal payout behaviour of firms, and τ_m is likely to enter cross–sectional regressions as a constant. Hence the sin of ommission appears preferable to the sin of commission in this case. In empirical testing a dividend payout term is included to proxy this effect. Expression (32) also is firm–centred, and ignores personal taxes and thus clientele behaviour which might mitigate tax differences at the corporate level. Empirically, investor tax rates are unavailable, but in any case we have little evidence that investors form equity clienteles around dividend policy, still less that there are segmented equilibria of the Miller sort, since in practice equity in the same firms is bought by both tax–exempt and top–rate taxpayers.

APPENDIX A SOME DERIVATIONS

A1 The Lagrangean

$$
\begin{aligned}
J_t = \\
&\mathrm{MAX}\Big[\{\tilde{X}_{O,t}-I_t+B_t-(1+r)B_{t-1}+N_t+pY_t-\tau_c\mathrm{MAX}\Big[0,\tilde{X}_{O,t}-rB_{t-1}+Y_t-\delta_t-L_{t-1}\Big] \\
&\qquad +\tau_m\Big[M_t-M_{t-1}\Big]\}\frac{\theta}{1-\tau_z}-N_t+\epsilon_t[V^*_{t+1}]\Big] \\
&+\lambda^d_t\,[\tilde{X}_{O,t}-I_t+B_t-(1+r)B_{t-1}+N_t+pY_t-\tau_c\mathrm{MAX}\Big[0,\tilde{X}_{O,t}-rB_{t-1}+Y_t-\delta_t-L_{t-1}\Big] \\
&\qquad +\tau_m\Big[M_t-M_{t-1}\Big]-c_d(V^*_{t-1}+N_t)] \\
&+\lambda^n_t.N_t \\
&+\lambda^b_t\,[B_t-c_b.K_t] \\
&+\lambda^y_t\,[Y_t-c_l.I_t] \\
&+\lambda^l_t\,[L_t-\mathrm{MAX}[0\,,-(X_{O,t}-rB_{t-1}+Y_t-\delta_t-L_{t-1})] \\
&+\lambda^m_t\,[M_t-\mathrm{MAX}\Big[D_t/(1-\tau_m)+M_{t-1}-\mathrm{MAX}[0,X_{O,t}-rB_{t-1}+Y_t-\delta_t-L_{t-1}],0\Big]
\end{aligned}
$$

A2 Shadow price on tax losses

Differentiating the objective function with respect to the state equation for losses, and setting $\delta J/\delta L_t=0$,

$$(1-\pi_{c,t+1})[\tau_c\cdot\frac{1}{1+\rho}\cdot\frac{\theta}{1-\tau_z}-\lambda^d_{t+1}\cdot\tau_c\cdot\frac{1}{1+\rho}]+\lambda^l_t-\pi_{c,t+1}\cdot\lambda^l_{t+1}\cdot\frac{1}{1+\rho}$$

hence

$$\lambda^l_t=[\Omega_{t+1}(1-\pi_{c,t+1})\tau_c+\pi_{c,t+1}\lambda^l_{t+1}](1+\rho)^{-1}$$

A3 Shadow price on imputation credits

The shadow price on unrelieved imputation credits is derived by noting that for $\delta J/\delta M_t=0$:

$$
\begin{aligned}
0 = &\qquad -(\tau_m-\tau_m/(1+\rho))\theta/(1-\tau_z)-\tau_m(\lambda^m_t-\lambda^m_{t+1}/(1+\rho)) \\
&-(\lambda^m_t+\lambda^m_t(\tau_m/(1-\tau_m.\pi_{m,t}))+\lambda^m_{t+1}(1/(1-\tau_m))(1/(1+\rho))\pi_{m,t+1}
\end{aligned}
$$

Collecting terms in the first two terms of the RHS, and recalling that $\Omega=\theta/(1-\tau_z+\lambda^m_t)$,

$$0 = -[\Omega_t - \Omega_{t+1}/(1+\rho)]\tau_m - \lambda^m_t[(1+\tau_m).\pi_{m,t}/(1-\tau_m)] + \lambda^m_{t+1}[(1/(1+\rho)\pi_{m,t+1}/1-\tau_m]$$

Multiplying through by $1-\tau_m$

$$0 = \quad -[\Omega_t - \Omega_{t+1}/(1+\rho)]\tau_m(1-\tau_m) - \lambda^m_t[1-\tau_m(1-\pi_{m,t})] + \lambda^m_{t+1}[\pi_{m,t+1}/(1+\rho)]$$

Rearranging for λ^m_t

$$\lambda^m_t = -\frac{[\Omega_t - \Omega_{t+1}/1+\rho]\tau_m(1-\tau_m)}{1 - \tau_m(1-\pi_{m,t})} + \frac{\lambda^m_{t+1}[\pi_{m,t+1}/1+\rho]}{1 - \tau_m(1-\pi_{m,t})}$$

which is Mayer's equation A.6

APPENDIX B FEASIBILITY OF AN INTERNAL DIVIDEND EQUILIBRIUM

There is a feasible internal equilibrium if (25) holds with equality for all possible values of π^m_t. To establish the feasibility of an internal equilibrium in terms of statutory tax rates it is necessary to simplify somewhat. Assume first that λ^d_t, λ^m_t are constant (for all t) so that Ω is constant and equal to $(1-\tau_d)/(1-\tau_m)(1-\tau_z) + \lambda^d$, and that π^m is constant, then from (23)

$$\lambda^m_t = -\frac{\Omega\,[\,1-1\ \ /\,1+\rho\,]\,\tau_m(\,1-\tau_m\,)}{1\ -\ \tau_m(\,1-\pi_m\,)\ -\ \pi^m/\,(\,1+\rho)}$$

Substituting into (25) gives

$$(25a)\qquad [(1-\tau_d)/(1-\tau_m)(1-\tau_z)+\lambda^d] = 1+c_d\lambda^d_t-\lambda^n_t$$

$$-\,[(1-\tau_d)/(1-\tau_m)(1-\tau_z)+\lambda^d]\ \ .\ \ \frac{[\,1-1\ \ /\,1+\rho\,]\,\tau_m\ \ \pi^m}{1\ -\ \tau_m(\,1-\pi^m\,)\ -\ \pi^m/\,1+\rho}$$

$$\text{At } \pi^m=0,\qquad (1-\tau_d)/(1-\tau_m)(1-\tau_z) = 1-(1-c_d\lambda^d_t)-\lambda^n_t$$

$$\text{At } \pi^m=1,\qquad (1-\tau_d)/(1-\tau_z) = 1-(1-c_d\lambda^d_t)-\lambda^n_t$$

Hence in a world without constraints an internal optimum is feasible so long as

$$(1-\tau_m)\leq(1-\tau_d)/(1-\tau_z)\leq 1$$

The right inequality appears likely to hold at least weakly in almost all tax regimes, since the effective personal capital gains tax rate rarely exceeds the top marginal income tax rate. Even when the statutory tax rates are equated, as in the UK from 1989, since capital gains were taxed on realisation rather than accrual, so that $\tau_d > \tau_z$ was most likely. The left inequality binds in the particular case of a zero capital gains rate and equality of the income tax and imputation rates. In the UK these two rates are equated with a view to acheiving dividend neutrality.

CHAPTER 3

THE SPECIFICATION OF THE EFFECTIVE CORPORATE TAX RATE UNDER UK IMPUTATION TAX RULES.

This chapter derives the expression for the effective corporate tax rate under UK imputation tax rules, which is estimated empirically in subsequent chapters. This expression emerges from a description of the UK tax system, but is shown to be consistent with the effective rate derived theoretically in Chapter 2 under certain assumptions and complementary to others which have appeared in the literature.
Some of its properties are explored by numerical simulation.

1 INTRODUCTION

The effective corporate tax rate faced by a firm differs from the statutory rate because of lags in the tax system. At least three types of lag are endemic in corporate tax systems.

Firstly, investment cash flows generate taxable events over several periods when tax depreciation is not 100% in the first year. The effects of this type of tax lag were thorouhly investigated by King and Fullerton (1984) ('K–F') who derived effective tax rates for different tax depreciation schemes in their study of the relative incentive to invest under different international tax systems.

Second, there is a statutory payment lag between the taxable event and the payment of tax. Over the period of this study a range of payment lags was encountered. In the UK companies formed after 1965 pay tax 9 months after the end of the accounting year, but companies already existing in 1965 were until recently allowed to retain their existing arrangement, which could have been between 9 and 21 months after the end of the

accounting year. Hence the lag depends on whether the company already existed in 1965, and its payment lag at that time. Furthermore, in practice there is often a lag of several years before a company's tax assessment is finally agreed and Teasedale and Devereux (1985) used IRS data to derive estimates of the proportion settled each year. However it is not obvious that these rates are appropriate to the marginal event, moreover they are averages across all companies. There are also statutory lags in the payment of imputation and personal taxes. Advance Corporation Tax (ACT) is payable 14 days after the end of the quarter in which the dividend is paid, and the receiver of the dividend will pay higher rates of tax with a lag of perhaps one year. Because they are based on realisations rather than accruals, capital gains tax (CGT) may be paid with a lag which can be considerable and King(1978) estimated the effective UK CGT rate at 50% of the statutory rate. Though there has been cross–sectional diversity in statutory payment lags this is unobservable in published accounts data, so is appropriately ignored in estimating the effective corporate tax rate.

However this does not apply to the third source of lag. Tax systems are assymetric in that tax losses do not generate instantaneous repayments of tax but can be carried forward, so a company with tax losses may be non–taxpaying for several periods before 'tax resumption' when it can recover the tax on marginal taxable cash flows. In an imputation system there is an additional level of non–taxpaying. There are limits on the company's ability to relieve tax credits on dividends, and companies may develop stocks of unrelieved imputation credits. These must be carried to other periods so that, in a parallel fashion, the tax credit on the marginal dividend payment will only be recovered when the stock of unrelieved ACT is consumed. Call the period until the firm resumes paying corporation tax its period of 'tax exhaustion' and denote it by 'p', and denote the duration of unrelieved imputation credits by 'q'. In contrast to the other two types of lag described above, the firm will not know p and q with certainty but in this chapter it is

assumed for convenience of exposition that future tax payments can be discounted at some appropriate rate, r[1]. Defining the effective corporate tax rate of a company at time t, τ^*_t, as (minus) the value at t of the incremental tax cash flows associated with a unit of positive taxable cash flow received by the company at t, τ^* can be specified in terms of p and q. This effective rate is compatible with those of K–F – substituting the elements of the effective corporate tax rate, τ^*, and the tax discrimination variable, θ, for the statutory corporate rate, τ_c,in their framework would measure the incentive to invest in a tax exhausted world.

An important question of principle is whether the company is the right 'entity' for which to measure an effective tax rate. In the K–F world the unit of analysis is the project; companies have no place, so company–level issues like tax exhaustion cannot easily be handled. King and Fullerton recognise this limitation and provide a simulation of their rates under the extreme assumption of zero–mainstream in perpetuity. Their main analysis, however, implicitly assumes perfect intra– and inter– company tax transfer markets. The present study makes the company the basic unit of analysis, but this assumption may also be limiting. The empirically observed entity is the group, so we are implicitly assuming frictionless transfers of tax losses and of unrelieved ACT, inter–group. A similar problem arises at a lower level still, since UK revenue law taxes types of income within companies, rather than companies. This legal formality has no economic significance so long as there is full loss offset within the company, which is generally the case except for rules restricting the imputation of dividends against overseas income and capital gains. The effect of these rules is discussed below.

This chapter proceeds as follows. Section 2 develops the concept of an effective tax rate

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[1]Whether this should be a certainty or a risky rate is an issue with a long provenance. A more poignant question is whether any risk–adjusted rate can satisfactorily model the risk in a complex call option such as the corporation tax claim. See Chapter 4.

in a classical tax system and generalises this to an imputation system. Expressions are developed for different assumptions on dividend elasticities. Section 3 models the effects of capital gains and overseas income, and some properties of the imputation effective rate are explored through numerical simulation. Section 4 suggests how the relationship between the concepts developed in the chapter and existing work on effective tax rates, notably that by King (1977) and King and Fullerton (1984), might be developed, and provides a simulation of their results to illustrate the implications of tax exhaustion.

2 THE EFFECTIVE CORPORATE TAX RATE

2.1 The effective tax rate in a classical system

Consider a 'classical' tax system in which the statutory corporation tax rate is $\tau_{c,t}$ on taxable profit in period t of X_t. If tax payment were instantaneous and there were full and instantaneous repayment of tax on losses, then

$$\tau_t^* = \tau_{c,t}, \text{ all } X_t \tag{1}$$

If the company pays tax with a statutory lag, s, then

$$\tau_t^* = \tau_{c,t}\cdot(1+r)^{-s}, \text{ all } X_t \tag{2}$$

However if the tax system does not repay tax on losses, and has no carry–back or carry–forward (cbcf) of losses, then

$$\tau_t^* = \begin{cases} \tau_{c,t}\cdot(1+r)^{-s} & X_t>0 \\ 0 & X_t\leq 0 \end{cases} \tag{3}$$

However with cbcf this changes. In the UK, losses can be carried–back against profits of the previous year[2] and forward indefinitely, so losses can generate tax repayments, but only by reducing taxable profits in other periods. Hence losses are taxed with a lag, p, which is the lag until the company next starts paying tax, its period of 'tax exhaustion'. p is found from

$$p = \text{MIN}[p] \text{ s.t. } 0 < \sum_{t-1}^{t+p}(X_t) \tag{4}$$

Thus

$$\tau_t^* = \tau_{c,t+p}\cdot(1+r)^{-p}, \text{ all } X_t \tag{5}$$

There is a t+p subscript on the τ_c because losses are taxed at the rate ruling when they

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[2]Until 1991; now 3 years.

are relieved.

2.2 The effective tax rate in an imputation system

In an imputation system such as the one prevailing in the UK dividends generate 'advance corporation tax' (ACT) payments to the Revenue. ACT payments provide the company with a credit against its corporation tax and the shareholder with a credit against basic rate income tax. Unconstrained, the ACT liability of any period is

$$ACT_t = D_t.\tau_m/(1-\tau_m) \tag{6}$$

where D_t is the net dividend paid (net of imputable distributions paid and received in period t,) and τ_m is the imputation rate. There are limits on the company's ability to use ACT to relieve its CT liability in any period. ACT can only be imputed on a 'gross dividend' or in a tax parlance a 'franked distribution' (= dividend plus ACT) no greater than pretax taxable profit, in other words, on a full distribution of taxable profit.

Clearly, the amount of underlying corporation tax that can be imputed to cover shareholders' income tax liability depends on the relationship between the imputation and CT rates. In a so–called 'full' imputation system $\tau_c = \tau_m$ whereas in a partial imputation sytem $\tau_c > \tau_m$. In general the UK has partial imputation, and the statutory basic rate of personal tax on dividend income is used as the imputation rate. However full imputation applies to small companies since they have a lower rate of corporation tax equal to the imputation rate, $\tau_c = \tau_m$. Under UK rules unrelieved ACT can be carried back 6 years (pre–1983, 2 years) and forward indefinitely. The lag, q, before ACT can be relieved is found as

$$q = MIN[q] \text{ s.t. } 0 < \sum_{t-6}^{t+q} (X_t.\tau_{c,t+q} - D_t.\tau_{m,t+p}/(1-\tau_{m,t}); \; p,q \geq 0 \tag{7}$$

Again, imputation takes place at prevailing rates (though for convenience we will ignore

the time subscript on the corporate and imputation rates henceforth). By inspection of (4) and (7) it is clear that $q > p$ must hold.

If the company has a stock of unrelieved ACT which will not be consumed for q periods then the tax cost to the company of an increment of (gross) dividend at t is

$$\tau_m.[1-(1+r)^{-(s+q)}] \tag{8}$$

It may be informative to decompose (8) into two components

$$\tau_m.[1-(1+r)^{-s}] + \tau_m.[(1+r)^{-s}-(1+r)^{-(s+q)}] \tag{8a}$$

The first term in (8a) measures the effect of the statutory lag, s, between payment and recovery of ACT. The second term is the shadow price on the ACT constraint. A rationale for an imputation tax system is that dividends should have a zero tax price for basic rate tax payers, ensuring neutrality of treatment with retentions. Clearly this does not hold even in a fully taxed (q=0) world because of the lag, s, between payment and recovery of ACT. More generally if the firm is tax exhausted for some period (p>0) a different split of the overall tax cost of dividends is interesting:

$$\tau_m.[1-(1+r)^{-(s+p)}] + \tau_m.[(1+r)^{-(s+p)}-(1+r)^{-(s+q)}] \tag{8b}$$

Now the second term shows the increment in the effective tax rate contributed by the period of unrelieved ACT once the firm is no longer tax exhausted. Imputation may affect the effective tax rate for two reasons: the increment of taxable income relaxes the constraint on the relief of ACT, the shadow price on this constraint is given by the second term in (8a); and the taxable income may itself generate an increment in dividend, taxed at this price.

2.2.1 The effect of imputation when dividends are invariant

If dividends have zero elasticity with respect to taxable income, then the classical marginal effective tax rate is mitigated under imputation by the ability to relax the constraint on ACT offset. From (5) and (8b) we have

$$\tau^*_t = \tau_c \cdot (1+r)^{-(s+p)} - \tau_m \cdot [(1+r)^{-(s+p)} - (1+r)^{-(s+q)}], \text{ all } X_t \tag{9}$$

This is the fundamental measure of the effective tax rate which is used in the remainder of this study. Taking derivatives,

$\delta\tau^*_t / \delta p < 0$ ($= 0$ in the limit for full imputation)

$\delta\tau^*_t / \delta q < 0$

$\delta\tau^*_t / dr < 0$ (since $q > p$)

In the special case of full imputation and constant tax rates, the effective tax rate takes the following simple form:

$$\tau^*_t = \tau_c \cdot (1+r)^{-(s+q)}, \text{ all } X_t \tag{9a}$$

Omitting the statutory lag and assuming p=0, 9a shows that for firms paying dividends below the limit, so that q=0, the effective tax rate is the classical rate given by (5). But in the limiting case of permanent unrelieved ACT (p=0, but $q=\infty$) the effective rate is:

$$\tau^*_t = \tau_c \cdot (1+r)^{-s} - \tau_m \cdot (1+r)^{-s}, \text{ all } X_t \tag{10}$$

Here increments of taxable income permit the firm to recover otherwise unrecoverable tax at the basic rate. Managers of companies with large stocks of unrelieved ACT are inclined to comment that under tax rates of say τ_c=.35, τ_m=.29 their effective tax rate is only 6%. We can see from (10) that, with a statutory lag of 1 year and a discount rate of 10%, $\tau^*_t = 35\%/1.1 - 29\%/1.1 = 5.45\%$. But if they expect to exhaust their ACT stock in 5 years, and under the assumptions we are currently making, from (9), $\tau^*_t = 35\%/1.1 -$

$29\%(1/1.1 - 1/1.16) = 30.8\%$. More generally, though, (9) shows that the benefit of relaxing the ACT constraint is limited to periods when the company has positive mainstream.

2.2.2 The effective tax rate with positive dividend elasticity

An increment in taxable profit will have different tax consequences if there is an induced change in dividend. Dividends may react with a complex lag structure, but we can get the flavour of the dividend effect by assuming the firm pays out in the same period a proportion d of the incremental profit. Now, for a unit increment of X the firm makes an immediate imputation tax payment of $d.\tau_m$ and can reduce mainstream by the same amount after a lag of q. So (9) becomes

$$(11) \qquad \tau^*_t = \tau_{t+p}.(1+r)^{-(s+p)} - \tau_{m,t}.[(1+r)^{-(s+p)} - (1+r)^{-(s+q)}] + d.\tau_{m,t}.[1 - (1+r)^{-(s+q)}], \text{ all } X_t$$

Table 1 evaluates (11) for three different combinations of p and q, and assuming first τ_m=.3, and τ_c=.52, which held over most of the period 1970–1984, then τ_m=.29, and τ_c=.35. It assumes a riskless, nominal, r=.15, and a statutory payment lag of 1 year, so s=1, and consider payout ratios, d=0 (equation 9), d=.25 and d=.5. With positive dividend elasticity a countervailing imputation tax effect is present. The real cost of the ACT associated with the dividend is an increasing function of q, and has a significant influence in maintaining high effective tax rates even for tax–exhausted firms. Table 1 suggests we will observe a wide dispersion of effective tax rates only if dividends are invariant to the marginal event, or if there is lengthy tax exhaustion.

3 RESTRICTIONS ON IMPUTATION: CAPITAL GAINS AND OVERSEAS INCOME

Corporation tax is primarily charged by type of corporate income, and the simplification of treating the company as unitary for corporation tax is only harmless so long as there is full loss offset and unrestricted imputation between types of income. Under the UK imputation system during the period of this study ACT could not be be imputed against income from capital gains[3], and imputation against overseas income was restricted This has implications both for measuring q and in some cases for corporate financial policy.

3.1 Capital Gains

If X'_t is taxable profit net of capital gains, the ACT lag becomes

$$q' = \text{MIN}[q] \text{ s.t. } 0 < \sum_{t-6}^{t+q} [X'_t.\tau_c - D_t.\tau_m(1-\tau_m)] \tag{7a}$$

implying an effective tax rate $\tau^*{}'_t < \tau^*{}_t$ (since $d\tau^*{}_t/dq < 0$)

The corollary is that the marginal after–tax value of trading income increases as capital gains are substituted for trading income, i.e. the opportunity cost of gains is

$$(1-\tau^*{}'_t)/(1-\tau^*{}_t) > 1 \tag{12}$$

From (11) this tax penalty is enhanced if part of the gain is distributed (d>0). The rationale for non–imputation was that in a continuing entity gains can be rolled over against replacement expenditure and rarely bear corporation tax. In practice taxable gains may be a sufficiently small part of taxable profit that they need not be distributed and the main occasion on which gains will be subject to double taxation is liquidation of the firm. At liquidation, p=0 and all after–tax profits are distributed, so from (11), collapsing all the lags

$$\tau^*{}'_t = \tau_{c,t} + (1-\tau_{c,t})\tau_{m,t}/(1-\tau_{m,t})$$

---

[3]Though it can now be.

By contrast trading income is taxed on liquidation at

$$\tau^{*}_{t} = \tau_{c,t}$$

3.2 Overseas Income

UK tax authorities do not allow imputation tax on UK distributions to be set against foreign tax credits. This has two implications. First, ceteris paribus, the larger the overseas component of a company's income, the greater the probability of it having unrelieved ACT, for precisely the reasons outlined in the previous section in the context of capital gains. However in the case of overseas income there was for a large part of the period of this study an overriding problem. Under pre–1984 law double tax relief (DTR) had to be offset after full ACT relief had been taken. This imposed a significant cost on companies through lost relief since DTR can only be used in the year and in the company in which it arises. If overseas income was X^{o}_{t}, DTR was lost if

$$(X^{o}_{t}.\tau_{c,t} - D_{t}.\tau_{m}(1-\tau_{m})) - DTR < 0$$

Hence only the firms with unrelieved ACT but paying mainstream on overseas income were firms to which this did not apply. However many companies were able to achieve a set–off of DTR before ACT, by the relatively simple expedient of holding overseas assets in a separate UK subsidiary, from and to which dividends could be paid so as to maximise reliefs. The 1984 Finance Act recognised this status quo by allowing firms to choose the order of set–off. This creates a problem for empirical work. The published DTR figure in accounts is net of loss of relief, but the modelling problem is that the set–off limit for ACT depends on the (unknown) structure of the group and the underlying rates of overseas tax. A more detailed discussion of the empirical implications of this problem is contained in the next chapter.

4 COMPARISONS WITH OTHER STUDIES.

4.1 Average effective tax rates

The 'effective tax rate' appears in many empirical studies of the incentive effects of taxation. As Fullerton(1984) points out in his survey of US studies, this is either an average or a marginal rate, and includes either corporate tax or total tax, that is, corporate tax plus personal tax borne by the investor. Another distinction which Fullerton could have made and is particularily important for present purposes is between marginal rates which reflect the tax rules relating to individual assets or projects, and rates which reflect the tax capacity of the firm as a whole.

Fullerton describes an average effective corporate tax rate as 'observed corporate taxes divided by "correctly measured" corporate income', and an equivalent total rate as 'observed corporate taxes plus property taxes plus personal taxes on interest and dividends, divided by total capital income'. Average corporate rates are usually measured at the company or industry level often with the motive of saying something about the distribution of the tax burden. Part of their appeal is that they seem easy to construct, but they are beset by problems of comparability in accounting data and in conceptualising 'correctly measured' corporate income. An early example was Siegfried(1974). Siegfried computed average corporation tax rates for IRS minor industries in 1963. His tax rates were the ratio of "actual tax liabilities" to "true accounting profits", and his methodology consisted of constructing a list of those special tax provisions which cause the actual corporation income tax structure to deviate from a 'basic, simple income tax system', then using this list to adjust the observed tax and profit numbers. Because of the conjectural nature of his adjustments he presented six sets of effective tax rate estimates. Estimation of an average total rate is hindered by the additional difficulty of measuring an average personal tax rate relating to income from corporate capital. Fullerton notes that the researcher is usually required to make

arbitrary assumptions about the order in which income is taxed, perhaps assuming that the rate which applies to corporate capital is the marginal rate.

Most studies use a notion of the marginal rate based on the work of Hall and Jorgenson(1967). There, the 'tax wedge' is defined as the pretax real rate of return, p, less the posttax real rate, s. The tax wedge, p–s, is divided by the pretax rate or the posttax rate to give an effective marginal tax rate, in the first case a 'tax–inclusive rate', t=(p–s)/p, and in the second case a 'tax–exclusive' rate, t=(p–s)/s.

4.2 King

King(1977) characterised tax systems in terms of two variables: the corporate tax rate, t, which is the tax borne when the firm makes zero distribution; and a 'tax discrimination variable', ϕ, which is 'the opportunity cost of retained earnings in terms of net dividends foregone' (King 1977, p 48). Hence (minus) ϕ measures the difference between the corporate and the total rate. King (1977) models the UK imputation system thus:

(12) $$T = \tau_c X + (\tau_d - \tau_m)D$$

where, T = total tax liability

X = taxable profits

D = gross dividend

τ_d = marginal rate of income tax

τ_m = rate of imputation

τ_c = corporate tax rate

In King's scheme the key variables are τ_c, the tax paid if no profits are distributed, and ϕ which is the opportunity cost of retained earnings in terms of net dividends foregone and which therefore measures, with changed sign, the additional tax associated with an extra unit of dividends. For equation (12) this gives

$$\phi = (1 - \tau_d)/(1 - \tau_m)$$

Dividing (12) through by X to give a (tax–inclusive) rate of tax per unit of taxable profit, X_t, and noting that d = D/X is the payout ratio on pretax profit defined earlier, yields King's model in a form that can be readily compared:

(12b) $$\tau^{*} = \tau_c + d(\tau_d - \tau_m)$$

The model developed in this chapter differs from King's in that it takes full account of lags in tax payments.

4.3 King and Fullerton

King and Fullerton (1984) estimate Hall–Jorgenson tax–inclusive rates for the US, UK, Sweden, and West Germany. Their approach is to construct rates for a range of representative investment 'projects', where a project differs by asset type, industry, type of finance, and type of owner. Three categories of each are considered, giving 81 analytical projects which they then weight using aggregate data on the composition of the capital stock and of financing to give an overall rate. Differential taxation implies that pre– and post–tax returns cannot both be equalised across projects, hence King and Fullerton generate effective tax rates under two return assumptions. First that p, the return before all taxes, is fixed, and second that the pre–tax return to savers, r, is fixed. They prefer to fix r, rather than s, their post–tax rate, because

'if arbitrage could eliminate differences in personal tax rates, the only possible equilibrium would be one in which all effective personal tax rates on capital income were zero. This does not seem to us to be a reasonable assumption.'(p12)

Table 2 shows their base–case results for the UK. A central assumption of K–F is that there is no tax exhaustion, and their main purpose is to analyse the taxation of income from capital in a taxpaying world. K–F recognise the problem of tax exhaustion and conduct a simulation assuming zero mainstream and zero imputation in perpetuity; the

results are shown as column three.

A full reconciliation of the results of the present study with the analysis of K–F would be the subject of another research project. However it is important to clarify the link between them, and to assist in this a computer programme was built to reconstruct the results of K–F[4] We use this model to recreate their results both in order to display them for comparative purposes, and to run a limited simulation of the effects of tax exhaustion. Table 3 contains some output from this exercise.

The upper left–hand panel of Table 3 decomposes a subset of K–F's UK effective tax rates. It shows in greater detail the returns, rather than effective tax rates, to the nine investor groups (three types of owner – households, tax–exempt institutions and pension funds, and three types of finance – debt, new issue equity and retentions) for a real investment with a fixed social return of 10% in just one of K–F's industry and asset groups – manufacturing plant. The actual inflation rate of 13.42% assumed by them is used. To yield a better insight into the mechanism of their model we show the 'cost of capital', which is the return to the company before investor taxes. The ruling set of capital allowances and grants, assuming the (then) statutory tax rate of 52% and the high UK inflation rate imply a significant tax subsidy and a return of 26.2% at the company level. The second part of each panel shows the effect of financing mode and the taxation thereof. The benefits of debt finance in an inflationary era, especially when provided by tax–exempt investors are seen in the return of 41.2% to this group. Relative to the social return of 10% this is an effective tax rate of –312% in K–F's terms. A major difference between the approach of K–F and the theoretical literature reviewed in the previous

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[4]K–F provide a very detailed summary of their (81) elemental tax rates in an Appendix. We were able to use these to confirm the accuracy of the reconstruction of the model. Our results accurately replicate theirs and replicated effective tax rates were within 1% of those of K–F in the case of retained earnings finance were there was some uncertainty about the averaging rule used in K–F.

chapter is that while the theoretical literature mainly concerns the analysis of real and financial equilibria in which marginal tax rates are equalised, the K–F rates are averages across computed marginal rates for different financing assumptions. It should be noted that there are enormous differences between the rates in the K–F segments. The overall investor return is the return for each investor/financing pair weighted by K–F weights which reflect the average importance of each type of finance and each type of investor in the UK economy at the time of K–F's study.

Our effective tax rates are unitary and reflect the interplay between mainstream and ACT exhaustion, whereas in K–F corporate taxation enters as two seperate and unrelated parameters, the statutory tax rate and the tax discrimination factor (1/(1–imputation rate)). To provide an insight into the effects of partial tax exhaustion in the K–F framework we reestimate the K–F results assuming an 'effective' corporate tax rate of 32% and an effective discrimination of 1.23. These contrast with the then statutory rates 52% and 1.429 assumed by K–F, and represent the effects of discounting these by 10% for 5 years. In other words a tax resumption lag of 5 years is assumed. The remaining three panels of Table 3 show the effects of these tax lags in the K–F system both individually and together.

It is informative first to assume that the company is tax–paying but has surplus ACT. There is no effect on the corporate return, and only the 'new equity' investor return is affected. New equity proxies dividend–receiving finance in the K–F scheme. Because of the low weight attaching to new equity finance, the overall investor return is only affected to a small extent; compared to the basic K–F results it falls from 14.9% to 14.7%. In terms of K–F effective tax rates surplus ACT has very little impact; they move from –4.9% (=(10.0–14.9)/10.0 – 1) to –4.7%, still reflecting a significant tax–subsidy relative to the 10% social return.

The effect of tax exhaustion is shown in the third and fourth panels, with and without the assumption of surplus ACT. What is striking is that the effect of tax exhaustion at the corporate level is fairly small, the 'cost of capital' falls from 26.3% to 25.4%, reflecting the dominant influence of inflation on capital allowances. Its effect is more pronounced at the investor level through its effect on interest deductibility, and because furthermore debt finance is relatively highly weighted in the K–F scheme.

The results in Table 3 can be used to provide estimates of the effect on investor returns of a sale of taxable capacity. The leasing of a unit of plant in the manufacturing sector from a fully taxpaying firm, compared with its purchase, by a firm which does not expect to pay tax for five years, increases returns to investors in that firm to 14.7% from 11.3% in a K–F world assuming the price of taxable capacity to the tax exhausted firm is zero.

TABLE 1 SOME SIMULATIONS OF EFFECTIVE TAX RATES

	τ_m=.3 τ_c=.52 d=0	τ_m=.29 τ_c=.35 d=.25	τ_m=.29 τ_c=.35 d=.5	τ_m=.29 τ_c=.35 d=.5
	%	%	%	%
p=0,q=0	45	30	32	32
p=0,q=9	27	11	17	23
p=9,q=9	11	8	13	19

TABLE 2 KING/FULLERTON EFFECTIVE TAX RATES FOR THE UK

		Fixed–p	Fixed–r	Fixed–p Exhausted
Asset	Machinery	–36.8	–57.5	15.5
	Building	39.3	56.4	38.9
	Inventory	39.5	45.9	22.7
Industry	Manufact.	–9.6	10.7	20.0
	Other Ind.	–5.4	12.0	26.8
	Commerce	36.2	55.0	34.1
Finance	Debt	–100.8	–	61.3
	New Shares	–4.2	–1.8	54.4
	Retentions	30.6	48.2	13.7
Owner	Households	42.0	104.6	78.2
	Tax–Exempt Inst.	–44.6	–34.5	–43.7
	Insurance Coys.	–6.7	14.5	12.4
OVERALL		3.7	30.0	24.7

TABLE 3

SIMULATION OF KING/FULLERTON FOR MANUFACTURING PLANT

In the first panel the results of King and Fullerton for UK manufacturing are modelled under their assumptions of full taxpaying. The results are then reestimated assuming, individually and combined, that the firm faces an effective corporate tax rate and an effective imputation rate below the statutory rate. There are two stages in the K–F modelling. First we find the 'cost of capital' implied by a social return of 10% given the prevailing corporate tax rate and allowances (K–F equations 2.23, 2.18–2.20). This is then turned into a return to each investor/type of financing pair (K–F equations 2.2, 2.4, 2.6, 2.24, 2.26–2.28) and an overall weighted investor return is shown.

King & Fullerton results

Fully taxpaying Corporate tax 52%, Discrimination 1.429

cost of capital 'i'				**0.263**
investor returns 's'		debt	equity	retentions
	households	0.245	0.071	0.043
	tax exempt	0.412	0.240	0.189
	insurance	0.285	0.174	0.132
investor returns overall				**0.149**

Simulation results

Corporate tax 52%, Discrimination 1.23

cost of capital 'i'				**0.263**
investor returns 's'		debt	equity	retentions
	households	0.245	0.042	0.043
	tax exempt	0.412	0.188	0.189
	insurance	0.285	0.131	0.132
investor returns overall				**0.147**

Simulation results

Corporate tax 32%, Discrimination 1.429

cost of capital 'i'				**0.254**
investor returns 's'		debt	equity	retentions
	households	0.116	0.064	0.037
	tax exempt	0.227	0.227	0.178
	insurance	0.143	0.163	0.123
investor returns overall				**0.115**

Simulation results

Corporate tax 32%, Discrimination 1.23

cost of capital 'i'				**0.254**
investor returns 's'		debt	equity	retentions
	households	0.116	0.036	0.037
	tax exempt	0.227	0.177	0.178
	insurance	0.143	0.122	0.123
investor returns overall				**0.113**

CHAPTER 4

A MODEL FOR ESTIMATING CORPORATION TAX PAYMENTS FROM COMPANY ACCOUNTS DATA

This chapter develops and tests a calibrated model of the UK corporation tax to generate company–level estimates of mainstream and advance corporation tax payments from the underlying economic data of the firm. A technical description of the model is provided and external validation is undertaken of certain aspects of model performance. Some of the difficulties of tax modelling using published accounts data are discussed, and an approach is adopted in which model estimates are modified by published tax data to reduce estimation error.

1 INTRODUCTION

To estimate effective corporate tax rates at the company level requires reliable data on past and projected corporate tax payments so as to forecast the duration of tax exhaustion and tax resumption dates. To provide this, a model of the process which generates tax liabilities is needed. This is so even for past periods; though it is possible to observe the tax charge in past series of company accounts and observe the lag until tax resumption, other crucial tax numbers, notably the ACT liability for a period and the stocks of tax losses and of unrelieved ACT which the firm is carrying, are not disclosed. Moreover, even for past periods one may prefer modelled to actual outcomes as more appropriately replicating the data available for managerial decisions. Clearly for periods subsequent to the research date only modelled data are available.

A number of researchers have modelled corporation tax at the company level. In the US, Auerbach and Jorgenson (1980), Joines (1981), and Cordes and Sheffrin (1983) derived estimates of effective tax rates on particular taxable events using a tax model. Cordes

and Sheffrin used the US Treasury Corporate Tax Model to find effective tax rates on debt interest. In the UK the IFS have, over some years, developed a company–level model of the UK corporation tax (see Mayer and Morris (1982), and Devereux (1986) for detailed descriptions). The IFS model has been used in a number of empirical studies (for example, Edwards, Mayer, Pashardes and Poterba (1985), Devereux and Mayer (1984), Mayer and Morris (1982b)) The UK Inland Revenue has a tax model (see Inland Revenue (1982), and Eason (1982)) and disaggregate models have also been produced by Levis and Morgan (1985), Robson (1985), while at Cambridge, Goudie and Meeks (1985) report a company–level tax model. The IFS kindly allowed us access to an early version of their model at the start of this project, and we subsequently shared our work with them. Though we use a different approach to certain problems, overall the approach of the two models is necessarily similar.

Naturally tax modelling is constrained by the limitations of published accounting data, which in important areas is insufficiently detailed and disaggregated to service the tax rules adequately. So the approach adopted in this study is to combine published and modelled tax data. Over the sample period we use published data on company tax payments and use the model to split the ACT and mainstream components, which are not published. The model is used to estimate tax payments post–1988.

It is necessary to clearly differentiate the 'tax model' from a 'company model'. The tax model described in this chapter calculates tax liabilities from the underlying economic data of the firm and is a 'calibrated' model or programming of the tax rules. When actual economic data for the firm are not available they have to be estimated using a company model. The company model used in this study is described in the next chapter. Though the emphasis may be on those variables which generate tax liability, it is necessary to provide a complete model of the company's flow of funds in order to generate

paths of balance–sheet and profit and loss variables which are internally consistent through time. The tax and company models are independent; that is, the company model is not tax–driven. They share this feature with all other company/tax models presently available. Since the purpose of this model is to test theory on the response of corporate behaviour to tax, it could be argued that to endogenise assumptions about tax–driven behaviour would generate dangerous circularity. In fact the development of a behavioural company/tax model remains the next challenge for researchers.

The following approaches to model validation were used:

–A detailed investigation was conducted of four major public companies which agreed to share their internal tax figures for the last ten years.

–A study in depth of the accounts of the Financial Times 100 companies was conducted.

–The estimated results from the model were compared with evidence available at an aggregate level on tax payments.

The chapter proceeds as follows. Section 2 describes the structure of the UK corporate tax system, and thus of the tax model. Section 3 shows how the UK corporation tax charge can be derived from published accounts. Section 4 discusses the problems associated with the choice of 'entity' for tax research. Appendix A details UK tax rates over the period 1970–1990. Appendix B lists the Exstat data codes referred to in the text and Appendix C summarises accounting rules for groups in the UK.

2 THE TAX MODEL

2.1 Introduction to the tax model

Exhibit 1 shows how a company's annual corporation tax payment is generated in the UK and thus shows, in outline, the structure of the tax model. The main adjustments to convert accounting earnings to taxable profit are for capital allowances (that is tax depreciation on structures and plant) and, until 1984, stock relief. Some expenditure, for example certain sorts of entertainment expenditure, is 'disallowable' altogether, and until 1988 capital gains were taxed at a lower rate than trading profits by introducing only a proportion into taxable profit. The corporate tax system is asymmetric in that there is no automatic refund of tax on taxable losses. However the asymmetry is mitigated by carryback and carryforward (cbcf) rules that permit some intertemporal transfer of tax liability, and rules that permit some transfer between companies within a group or consortium. In the UK, taxable losses can be set against group profits of the same or previous period, or be carried–forward indefinitely against profits of the same trade. Also, when available, first year investment allowances could be carried back against total profits of the previous three years. The balance of taxable profit after loss relief is apportioned to fiscal years and taxed at the average corporation tax rate for that year to give the UK corporation tax charge for the year.

EXHIBIT 1 **THE MAIN COMPONENTS OF CORPORATE TAX LIABILITY IN THE UK**

TRADING PROFIT = accounting profit, pre–dividends and interest paid and received (i.e. EBIT)	X_O
ADD:	
Depreciation	DEP
Disallowables	
Other income: Capital gains, Interest received	I^+
LESS:	
Interest paid	$-I^-$
Capital Allowances	–CA
Stock Relief	–SR
TAXABLE PROFIT	X
LESS: Loss relief	–L
TAXABLE PROFIT AFTER LOSS RELIEF	TPA
@ CT rate	
UK CORPORATION TAX LIABILITY	$\overline{CT}$
LESS:	
Double–Tax Relief	–DTR
Advance Corporation Tax	–ACT
'MAINSTREAM' TAX PAYABLE	MAIN

NOTE This is the equation which calculates the tax liability of the firm. The variables in the right hand column are the variable names of the modelled elements of the tax system. Elements taken untransformed from accounting data are defined in terms of Exstat variables as:

EBIT	=	C34–C501+C54–C32
I^-	=	C53+C54+C55
DTR	=	C39
CT rate	=	C36
CT(where available)	=	C35+C502+C503

Part of the corporation tax liability is treated as already discharged, by the net of Advance Corporation Tax (ACT) collected and borne by the company on dividends; and by double–tax relief (DTR), which is the offsetable part of overseas tax. The balance is known as 'mainstream'. Tax rules distinguish 'franked' distributions on which ACT must be paid by the company, and 'unfranked' payments from which income tax must be deducted. In either case the company has to pay the ACT or income tax to the Revenue within the 'accounts return period' in which the payment or distribution was made. These periods last three months, unless the company's year–end does not coincide with a calendar quarter, in which a fifth 'quarter' is defined. Mainstream is collected with a much longer lag. If the company was carrying on its trade under the same name prior to 1.4.1965 its mainstream is payable on the 1st of January after the first of April after its year–end. Other companies pay 9 months after their year–end. Hence a pre–1965 company with a 30th April year–end pays tax 20 months after the accounting year–end; with a 30th March year–end, 9 months. If we add six months for the lag between the average taxable event and the accounting year–end, we get a statutory lag of 15 months for a post–1965 company, and between 15 and 26 months for the pre–1965.

The question arises whether the Exstat tape gives sufficient history for modelling. To get a longer history the IFS, for example, use DTI data back to 1948 where available for certain companies. It should be noted that without carry–back and carry–forward in the tax system no history at all would be needed save perhaps for finding trends in underlying variables. Time dependencies in the tax system relate principally to stock relief, ACT, tax losses, and capital allowances. Stock relief and ACT were not introduced until 1973 and 1974 respectively, and this determined the choice of starting point for the study. Similarily carried–forward tax losses were probably not significant prior to the 1970's. On the other hand companies were carrying part–tax–depreciated assets at the beginning of the observation period and the size of these unused tax allowances is unobservable. It

is suggested below that the likely size of these residual capital allowances, and the subsequent impact of inflation over the period, make the probable impact of misestimation negligible. Hence the length of the observation period does not appear to be a source of misestimation.

Exhibit 1 describes the equation of the corporate tax liability in terms of the main components of taxable profits. Some elements enter the equation untransformed from accounting data, and require no further comment; these are trading profit, and interest paid and received. Other items are not disclosed in accounts and cannot be modelled; these are disallowables and capital gains. In tax computations, a lower capital gains rate was implemented pre–1988 by taking a proportion of capital gains into taxable profit. Though databases do carry a capital gains item, its disclosure is not reliable, and even where available the tax modeller cannot ascertain the extent to which gains were 'rolled–over' against subsequent acquisitions. Furthermore certain items of expenditure, for example some entertainment expenses, are disallowable for tax, and there is a similar problem here since we cannot tell from accounts what proportion of general expenditure is disallowable. Hence capital gains and general disallowables are not modelled. These are a source of model error, though they are unlikely to be significant. On the other hand double tax relief is a real problem for tax modelling. The number is disclosed, but the necessary data to model it are not available. Hence the arbitrary convention was adopted of assuming that DTR continues to be the same proportion of taxable profit as in previous years. A fuller description of the problem posed by overseas activities for tax modelling is given later. The major modelled elements of the tax model – capital allowances, stock relief, taxable losses and ACT – are described below:

2.2 Capital allowances

In the UK, tax depreciation or 'capital allowances' can be claimed on qualifying

investment in industrial buildings and in plant and machinery, with different rules applying to these two classes of asset. In the year of purchase both classes of asset qualify for first–year allowances (known as 'initial allowances' for buildings), and when these are not available annual writing–down allowances are available. The rates which applied from 1970–1990 are shown in Appendix 1. The key difference between the tax treatment of the two classes is that writing–down allowances for buildings are straight–line whereas plant writing–down allowances are calculated on the reducing balance of undepreciated expenditure. Exhibit 2 displays that part of the tax model relating to capital allowances. Several practical issues arise in modelling capital allowances from published accounting data:

1. There is a problem of 'disallowables' associated with capital allowances since accounts do not show what proportion of investment in buildings qualifies for capital allowances, and, more perplexingly, some part of this buildings expenditure may be treated as plant and machinery.
2. It is necessary to make assumptions about the effect on the tax base of transactions in partly tax–depreciated assets, through asset–disposal or the acquisition or divestment of subsidiaries, since the tax–effect of these transactions is not disclosed in accounts.
3. It is necessary to estimate the inherited legacy of capital allowances at the beginning of the observation period.
4. Database numbers on fixed asset additions are of dubious quality, with a significant incidence of zeros and missing values on the database, and some uncertainty about the treatment of leased assets in this period.

In the tax model capital allowances are calculated by applying prevailing rules and rates to recorded investment in plant and machinery, and in buildings. Published data on additions are used when available. If a company has missing data in all years it is

assumed to invest at the same rate as its industry, based on CSO data. It is assumed that all expenditure on plant and machinery qualify for allowances and, in common with other published work, that 65% of new investment in plant and buildings is industrial in the sense of qualifying for capital allowances. The buildings and plant of subsidiaries acquired and divested are assumed to enter and leave at the same stage of tax depreciation as the average for the existing assets of the firm itself. In the case of disposals plant and machinery are assumed fully tax depreciated on disposal, but that buildings which are disposed of are assumed to have the average tax profile of the company's other structures.

Whatever starting point is chosen for the observation period it is necessary to make assumptions about the opening 'pool' of plant and machinery expenditure for writing–down allowances and about the legacy of buildings allowances. To estimate this accurately one would need to decompose the opening stock of buildings, and of plant and machinery, into investment of different vintages, and pass this data through the tax rules prevailing at different dates. This vintage data is not published in accounts. One approach might be to estimate asset histories using data from the DTI tape, which has a longer provenance. However only some of the firms we want to model have histories on the tape, and even for those which do, the DTI data is limited: disposals data is not available, nor even the gross split between plant and buildings. Instead the following procedure is adopted. It is assumed, consistent with capital allowance rates, that the companies in the sample hold plant and machinery for fifteen years and that buildings have a life of twenty–five years. Hence it was assumed that opening gross assets were acquired in proportion to the gross investment of the company's industry over the preceding 15 or 25 years as appropriate. By reference to the prevailing tax rates the legacy of capital allowances implied by that investment profile is calculated. This approach is unlikely to impart significant misestimation, even for companies whose

investment profile diverges from the 'norm'. It should be recalled that tax allowances are not index–linked, so the impact of errors in the estimated value of the pool in 1970 on post–1984 tax liabilities is likely to be minimal. We test this assertion in a simulation whose results are shown in Table 1. This simulation finds the effects of different starting assumptions on the tax resumption lags predicted by the model for ten randomly chosen actual companies. Table 1 shows that this small sample contains about the 'right' proportion of tax exhausted firms in 1975 and 1980 relative to the proportions in the population as a whole, described in the next chapter. It shows the effect on the predicted tax resumpion lag of assuming that the tax–written–down pool of plant and machinery as a proportion of their gross book value is 50% and the limiting values 0% and 100%, rather than the actual values estimated by the method described above which are typically in the range 25%–35%. The ratio of gross plant and machinery to sales for each company is also shown. The opening pool assumption is made in 1972. The effects are shown on 1975 and 1980 estimated tax resumption lags. Though the companies chosen embody a wide disparity in capital intensity, with ratios for Plant&Machinery to Sales ranging from 1% to 53%, as predicted the variation in assumption about the tax status of the initial pool has virtually no effect. Only when the most extreme assumption is made, that the 1972 gross book assets is fully available for future tax deduction, is there a shift in the tax resumption lag of one company (company 5) by one year. The effects on 1984 were also calculated but are not shown, as no company was affected by the change of assumptions so far ahead.

Finally it should be noted that the model assumes that all capital allowances are used as soon as they become available. In reality there are reasons why firms can find it advantageous to defer allowances – to avoid losing DTR, or because future tax rates are expected to be higher, either because of a change in the law or because the company has

previously been taxed at the small company rate.

TABLE 1 **OPENING POOL SIMULATION**

In this simulation we show the effects on the tax resumption lags predicted by the model for ten randomly chosen actual companies, of assuming that the tax–written–down pool of plant and machinery as a proportion of their gross book value, rather than the actual values(estimated by the method described in the text) which are typically in the range 25%–35%, is 50% and the limiting values 0% and 100%. The ratio of gross plant and machinery to sales for each company is also shown. The opening pool assumption is made in 1972. The effects are shown on 1975 and 1980 estimated tax resumption lags. 1984 was calculated but is not shown as it is unaffected by the change of assumptions

		1975 TAX RESUMPTION				1980 TAX RESUMPTION			
COMP	P&M/ Sales	Act	0%	50%	100%	Act	0%	50%	100%
1	.088	0	0	0	0	0	0	0	0
2	.387	0	0	0	0	2	2	2	2
3	.500	0	0	0	0	2	2	2	2
4	.399	0	0	0	0	0	0	0	0
5	.133	11	11	11	11	6	6	6	6
6	.163	10	10	10	11	5	5	5	6
7	.553	1	1	1	1	0	0	0	0
8	.438	0	0	0	0	0	0	0	0
9	.012	0	0	0	0	0	0	0	0
10	.224	0	0	0	0	2	2	2	2

EXHIBIT 2 **CAPITAL ALLOWANCE MODEL**

In this description C* variables are Exstat variables (for definition see Appendix)
Variables without time subscripts are current year

Plant and Machinery Allowances

$$IPM = CC10$$
$$PMSUB = (CC12 + CC13) * PPOOL(-1)/C87(-1)$$
$$FYA = (IPM + PMSUB) * FYRA$$
$$WDA = PPOOL\,(-1) * WDRATE$$
$$CAP = FYA + WDA$$
$$PPOOL = PPOOL(-1) + IPM + PMSUB - CAP$$

Buildings Allowances

$$IPROP = CC2*0.65$$
$$IA = IPROP * (IARA - PWDRATE)$$
$$S = (1 - IARA)/PWDRATE$$
$$PRSUB = (CC3+CC4+CC5) * 0.65/C83$$

If N indexes horizon, and I the current period for J = I+1 to I+S(I+S<N)

$$WDAP(J) = PROLEG(J)$$
$$WDAP(J) * (1+PRSUB) + IPROP * 0.65 * IARA$$
$$CAM = IA + WDAP$$

Total Capital Allowances

$$CA = CAP + CAM$$

NOTATION

CA	= total capital allowances
CAP	= capital allowances on plant and machinery (p&m)
CAM	= capital allowances on buildings
IPM	= investment in p&m in the year
IPROP	= investment in buildings in the year
PPOOL	= pool of undepreciated investment in plant
PMSUB	= addition to pool through net acquisition of subsidiaries in the year
FYA	= p&m first year allowances
FYRA	= p&m first year allowance rate
WDA	= p&m writing down allowances
PRSUB	= proportionate uplift to buildings allowances through net acquisition of subsidiaries in the year.
IA	= initial allowances
IARA	= initial allowance rate
PWDRATE	= initial allowance rate
PROLEG	= legacy of buildings allowances from period pre–study
WDAP	= writing–down allowances for property

EXHIBIT 3 STOCK RELIEF MODEL

1973 – 1980 SYSTEM

$$SR = MAX[\Delta S - \alpha(EBIT + DEP - \beta.CA), O]$$

$\alpha = 0.1$ in 1973,1974, $= 0.15$ otherwise
$\beta = 0.0$ in 1973,1974, $= 1.00$ otherwise

1973 – 1980 Clawback

$$CLAWB(J) = MAX\left[\sum_{I=J-1}^{\gamma} SR(I) - \sum_{I=J-1}^{\gamma} CLAWB(I), 0\right]$$

$\gamma = 1973$ for 1974–1978
$\gamma = 1975$ for 1979–1980

1973 – 1980 Total Stock Relief

$$SR = \delta SR - (1-\delta)CLAWB$$

$\delta = 1$ if $\Delta S \geq 0$
$\delta = 0$ otherwise

1980 – 1984 SYSTEM

$$SR = MAX[S(-1)*\Delta PS, 0]$$

NOTATION

SR	= Stock relief
S	= Stocks
ΔS	= Change in stocks since previous period
EBIT	= Earnings before interest paid and tax
DEP	= Depreciation
CLAWB	= Clawback of stock relief
ΔPS	= Change in the retail price index

2.3 Stock relief

From its introduction in 1973 by Chancellor Healey, to its abolition in 1984 by Chancellor Lawson, UK firms were able to claim 'stock relief'. These rules were designed to permit companies to offset some of the cost of replacing stocks in inflationary times. The rules changed on several occasions during the period, and a significantly simpler system was introduced from 1981 to 1984. Exhibit 3 displays that part of the tax model relating to stock relief. In outline, between 1973 and 1988 the firm could charge the increase in the value of stocks, less some proportion of income, as an expense. If stocks fell, previous unrecovered stock relief was clawed–back. In 1979–1980 stock relief for 1973 and 1974 were deemed unrecoverable. In 1980 clawback less 5% of opening stock could be deferred. Post 1980 stock relief was calculated as the change in the retail price index over the year applied to opening stocks.

There is the possibility that some stocks may not qualify for stock relief. We asked the four firms to which we spoke the extent to which the assumption of full stock relief was justified. Three replied that it was not significantly unrealistic. The fourth ran its own, small–scale, tax prediction model and had been forced to give some thought to these issues. It found that 10% of its general expenditure and capital investment were disallowable, and that only 50% of its UK stocks qualified for stock relief. The stock problem appeared to be particular to its industry, however, and it has been assumed that inventories qualify in full for stock relief.

2.3.1 Testing the capital allowance and stock relief model

In a joint exercise with Mike Devereux of the IFS the performance of the LBS and IFS[1] models were tested in terms of their ability to predict allowances and stock relief, using

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[1]The model developed for the present research is referred to below as the 'LBS model', while the 'IFS model' is model described earlier, developed at the Institute of Fiscal Studies.

unpublished data from the four companies. Table 2 shows a comparison of actual stock relief and capital allowances and forecasts by our model and that of the IFS for certain years for three of the four firms. Comparison would obviously have been enhanced if all years had been available from all firms, but they were not. The figures have been scaled to protect anonymity. The spirit in which these results are presented is purely illustrative and suggestive, and they obviously cannot be used to draw firm conclusions about the comparative performance of the models. Clearly, for the reasons given, modelling of tax variables is inexact. It will be noted in Table 2 that there are quite often displacement errors of a year in model estimates. These errors are not likely to be significant in the context of forecasting tax resumption. Hence Table 2 shows the sum of errors for each company, but totals the absolute errors across companies and expresses these as a proportion of the total of actual capital allowances and stock relief. For example, in the case of capital allowances the aggregate errors for company 1 total –20 for the model against 72 for IFS, and for company 2 –92 for the model and –1 for the IFS. For all three companies the errors are 43.3% and 34.8% of the actual allowances. Thus for this sample the error rate is smaller for IFS. For stock relief the reverse is the case. In terms of totals, the LBS model appears to perform quite reasonably, at least for the three companies under review, in predicting stock relief though for these companies stok relef is less significant than capital allowances. Performance of both models in predicting capital allowances is less impressive with an average absolute error of 30%–40%. A number of reasons were given earlier in the chapter why modelling of tax variables may be inexact, and in empirical work actual tax data are used where available, in preference to modelled.

TABLE 2 MODEL VERSUS ACTUAL FOR THREE COMPANIES

The first column for each company records the actual data, when available, from the company. The second column contains our model estimates and the final column those of the IFS. The cumulative error is shown for each model and company, and the total of these (absolute) errors is expressed as a percentage of the the total actual.

	Company 1			Company 2			Company 3				
	actual	model	ifs	actual	model	ifs	actual	model	ifs		
CAPITAL ALLOWANCES ('mn)											
1983	45	23	58	28	52	86	66	80	106		
1982	29	24	50				54	79	83		
1981	23	24	41				78	180	91		
1980	16	21	26				112	280	156		
1979	20	21	30	29	15	26	104	143	155		
1978				48	15	46	102	84	166		
1977				62	20	68	98	100	130		
1976				69	52	79	45	51	62		
total act	133			246			659				**1038**
total est		113	205		154	245		997	952	**mod**	**ifs**
error		–20	72		–92	–1		338	293	**450**	**366**
										%	**%**
										43.3	**34.8**
STOCK RELIEF ('mn)											
1983	9	13	10	6	15	13	11	18	12		
1982	9	15	12				11	20	14		
1981	12	20	15				17	29	20		
1980	15	0	15				29	23	18		
1979	11	17	19	6	4	0	19	32	29		
1978				–10	0	–10	10	0	7		
1977				14	–11	39	16	–1	–1		
1976				30	37	57	18	22	21		
total act	56			46			131				**233**
total est		65	71		45	99		143	120	**mod**	**ifs**
error		9	15		–1	53		12	–11	**22**	**79**
										%	**%**
										9.4	**33.9**

2.4 Modelling ACT

The company's ACT payment each period is the net of ACT collected on franked distributions and borne on franked investment income (FII). FII is disclosed in accounts and recorded on databases. The ACT collected for a period is based on cash flows, not accruals. Since payment dates for dividends are not recorded on databases, it was assumed that all companies pay their interim dividend during the year in question, and their final dividend during the next. (This will not always be true. One of the four companies paid both dividends after the year–end.) So the dividend paid in a period is found by combining 'proposed dividends' from the balance–sheet and 'dividends paid and proposed' from the P&L, thus

$$\text{DIV} = \text{Proposed Div}(-1) + (\text{Div Paid and Proposed} - \text{Proposed Div})$$

which in data terms is $\text{DIV} = \text{C154}(-1) - \text{C154} + \text{C47} + \text{C48}$

'Dividends paid' in both the P+L and balance–sheet are shown net of ACT. Hence ACT collected is calculated, where τ_m is the rate of imputation, as

$$\text{ACT} = \text{DIV}.\tau_m/(1-\tau_m)$$

There are potential sources of error in modelling ACT. The company can make franked distributions other than dividends; for example, ACT can arise on certain share distributions and repurchases. This is unlikely to be a major source of misestimation in practice. A problem which is harder to assess concerns dividends paid overseas. Under some double–tax treaties the company may be able to pay dividends to overseas investors 'gross' of some or all the tax credit. This would lead to an overestimate of ACT.

The estimation of the limit on the offset of ACT is a more intractable problem and concerns the relationship between ACT and Double–Tax Relief. In principle the company deducts any ACT it has collected from its overall UK corporation tax assessment and pays the remainder as mainstream tax. However a company is not

allowed to offset ACT on a gross dividend which is greater its taxable income. So, for companies with no DTR, the offset of ACT is effectively limited to CT.30/52 (in this discussion, for convenience, .30 and .52 personal and corporate tax rates are assumed respectively) leaving a wedge of mainstream, CT.22/52, which must be paid even if there is unrelieved ACT.[2]

A more difficult modelling problem, concerns the relationship between ACT and DTR. Under pre–1984 law DTR had to be offset after full ACT relief had been taken. This had two effects. First it imposed a significant cost on companies through lost relief since DTR can only be used in the year and in the company in which it arises. Second it meant that the only firms with unrelieved ACT but paying mainstream were firms with DTR<CT.22/52. However many companies were able to achieve a set–off of DTR before ACT, by the relatively simple expedient of holding overseas assets in a separate UK subsidiary, from and to which dividends could be paid so as to maximise reliefs. The 1984 Finance Act recognised this status quo by allowing firms to choose the order of set–off. The published DTR figure in accounts is net of loss of relief, but the modelling problem is that the set–off limit for ACT depends on the (unknown) structure of the group and the underlying rates of overseas tax, and can range from MIN(CT–DTR, CT.30/52) to (CT–DTR).30/52. In testing, the more restrictive (CT–DTR).30/52 produced ACT estimates which better predicted recorded ACT stocks.

2.4.1 Testing the ACT Model

The set–off limit for ACT depends on the (unknown) structure of the group and underlying rates of overseas tax, and can range from a less restrictive, 'l', limit of MIN (CT – DTR, CT.30/52) to the more restrictive, 'r', (CT–DTR).30/52. The predictive power of each of these definitions of the limit was tested. If companies have unrelieved

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[2]In the UK this limit was based on taxable income excluding capital gains prior to 1988.

ACT they have two alternatives, they can write it off, or carry it as a deferred tax asset. SSAP8 requires that 'Any irrecoverable ACT (ACT the recoverability of which is not reasonably certain and foreseeable) should be written off in the profit and loss account in which the related dividend is shown .... The amount of irrecoverable ACT should, therefore, be separately disclosed if material'. Hence ACT write–offs provide a signal of zero mainstream. The 1986 Survey of Published Accounts (SPA) found 145 companies writing–off and 13 writing–back ACT in 1981–1982, and we found all bar one of the 95 FT100 companies we sampled accounted for this item in 1983. Datastream (but only recently Exstat) collects the annual P&L write–off/write–back of irrecoverable ACT, and some researchers, for example Mayer et al.(1985), have used this figure to signal tax exhaustion. Alternatively, if the company considers ACT may be recoverable in the future it may hold a balance of recoverable ACT in the deferred tax account. In 1981/2 177 of the SPA 300 disclosed such an amount. Neither Datastream nor Exstat records this stock.

Using Datastream data recorded ACT write–offs from 1973 onwards were summed for the FT100 sample. It was immediately apparent that some companies had written–back more ACT than they had written–off, suggesting that the irrecoverable ACT figure is subject to revisions, which are not shown in the published figure. So although an ACT write–off in any year is a sufficient signal of an ACT constraint in that year, it is not a necessary one, and both as a signal and for estimating the stock it only tells part of the story. To get a more complete story figures were collected from company accounts for the FT100 sample, for the deferred tax asset in 1984. In many cases the figure was less than the ACT arising in 1984. This is because, under SSAP 8, companies without an ACT constraint may show a deferred ACT asset for the ACT on dividends paid after the year–end. To eliminate this the 1984 ACT figure was deducted, though this probably overcompensates, since it assumes all firms were accounting this way, and that the whole

of the 1984 dividend was payable after the year–end. Since write–off and carry–forward represent accounting alternatives, the (positive) write–offs were added to this revised deferred asset to give an independent measure of the company's accumulated unrelieved ACT, written–off and carried–forward, in 1984. Some companies disclose this amount, and where available this figure was used. In 9 out the 64 sample companies no deferred asset data was available, so in the end observations were available on 55 companies. The performance of the estimated 1984 stock of unrelieved ACT was then tested, using the 'l' and 'r' limits, in predicting this figure. This appeared to be a demanding test, not just of the two limit assumptions, but of the whole methodology, including indirectly the corporation tax figures used to estimate taxable profit. Any cumulative error would be most apparent by 1984.

The performance of the estimates is shown in Table 3. 48 out of 55 companies are correctly classified by the r limit, and in only 5 cases is the model failing to predict a positive balance. Moreover closer inspection shows that in most of these cases the stock being missed was small. The more restrictive limit appeared to predict unrelieved ACT more effectively than the less restrictive. As a second check we tested how the 'r' limit performed year by year in predicting write–offs of ACT. This is of course not an independent test, since it in part uses the same data, though it is informative. In this case there were 60 companies in the sample. The results are shown in Table 3. Since, as noted, ACT write–offs are a sufficient but not a necessary condition for the existence of unrelieved ACT we are not indifferent between the two types of error, and would expect a higher level of predicted than actual write–offs, as is the case. In 12 cases write–offs were predicted but not found, while in no cases was the reverse the case. In half of the twelve cases the disparity was insignificant, however, with write– offs predicted in only 1 or 2 years out of 11. Moreover within the 37 cases correctly classified as having unrelieved ACT, on average write–offs were predicted in approximately twice as many years as

occurred. On the other hand the results in Table 3 could be interpreted as suggesting a bias towards overprediction of unrelieved ACT, were it not for the fact that the results of the previous test suggest the opposite. Two statistics of significance emerge from the tables below. Using actual, rather than forecast, data, 56% of (the FT100) companies appeared to have stocks of unrelieved ACT in 1984, and 61% wrote–off ACT at some stage over the period.

2.5 Tax Losses

Though the corporate tax system is asymmetric in that there is no automatic refund of tax on losses and there are limits on the offset of ACT and DTR, the asymmetry is mitigated by carryback and carryforward (cbcf) rules that permit some intertemporal transfer of tax liability, and group relief rules that permit some transfer between companies. Taxable losses can be carried back one year or forward indefinitely in the UK. ACT can only reduce mainstream in any year up to a limit which is the taxable income of the year multiplied by the personal tax rate, however unrelieved ACT can be carried back six years (pre–1983, three years), or forward indefinitely. A form of loss carryforward can be achieved by not claiming capital allowances, since, though first–year allowances are lost, writing–down allowances can be carried forward if not claimed. Also, when available, first year allowances could be carried back against total profits of the previous three years. DTR cannot be transferred through time or between companies, so it is lost if not used in the year and the company in which it arises, which means that the prime tax planning concern is to make best use of DTR. The company has the option not to claim all available capital allowances, or fully offset losses, and it will often be worthwhile exercising this option so as to avoid losing DTR. Exhibit 4 details the modelling of the cbcf rules for tax losses and unrelieved ACT.

TABLE 3 PREDICTIVE PERFORMANCE FOR ACT STOCKS

a MODEL PERFORMANCE IN PREDICTING UNRELIEVED ACT STOCKS

The set–off limit for ACT depends on the structure of the group and underlying rates of overseas tax, and can range from a less restrictive, 'l', limit of MIN (CT – DTR, CT.30/52) to the more restrictive, 'r', (CT–DTR).30/52.

	l	r
CORRECTLY CLASSIFIED		
as zero stock	22	22
as positive stock	18	26
MISCLASSIFIED		
predicted unrelieved ACT when there is none	0	2
predicted zero unrelieved ACT when it is +ve	15	5
TOTAL	55	55

b PERFORMANCE IN PREDICTING ACT WRITE–OFFS

CORRECTLY CLASSIFIED	
as write–off	37
as no write–off	11
MISCLASSIFIED	
predicted write–off when there is none	12
predicted no write–off when there is one	0
TOTAL	60

EXHIBIT 4 MODELLING CARRYBACK AND FORWARD TAX LOSSES

– carryback of first–year allowances
for all I, 1 to N

$$\begin{aligned} CBFYA &= -TPA \quad (FYA > -TPA) \\ &= FYA \quad (\text{otherwise}) \\ TPA &= TPA + CBFYA \\ TPA(-3) &= TPA(-3) - CBFYA \end{aligned}$$

– carryback of tax losses

$$\begin{aligned} TPA(-1) &= TPA(-1) - MAX[TPA,0] \\ TPA &= MIN[TPA,0] \end{aligned}$$

– carryforward of tax losses
for all I, 1 to N

$$\begin{aligned} CFL &= -MIN[TPA,0] \\ TPA &= MAX[TPA,0] \\ TPA(+1) &= TPA(+1) - CFL \end{aligned}$$

UNRELIEVED ACT

$$\begin{aligned} OFFLIM &= MIN[(CT*TPE/CTRATE),(CT+DTR)] \\ UNOFF &= OFFLIM - ACT \end{aligned}$$

– carryback of ACT
for I = 1 to γ (γ=2 for 1973–1983, γ=6 thereafter)

$$\begin{aligned} UNOFF(-I) &= UNOFF(-I) + MIN[UNOFF(1-I),0] \\ UNOFF(1-I) &= MAX[UNOFF(1-I),0] \end{aligned}$$

– carryforward of ACT
for I = 1 to N

$$\begin{aligned} UNOFF(+1) &= UNOFF(+1) + MAX[UNOFF,0] \\ UNOFF &= MIN[UNOFF,0] \end{aligned}$$

NOTATION

UNOFF = Unrelieved ACT/ spare ACT capacity
OFFLIM = Limit for ACT offset
TPA = Taxable profit
CFL = Carried–forward losses
CBFYA = Carried–back first year allowances
TPE = Basic rate of income tax/ imputation rate

3 INFERRING THE TAX CHARGE FROM ACCOUNTS DATA

This section discusses the use of accounting disclosure on taxation in inferring the corporation tax charge.

3.1 The tax charge in the P&L

Some researchers have been inhibited from using the published UK corporation tax charge because of a concern that it was polluted by more or less arbitrary accounting adjustments associated with 'deferred tax'. For early research, over the period, say, 1948–1970, this fear may be justified. The DTI tape, which is the only machine–readable UK database covering that period, carries a single UK tax charge which is a composite of UK tax charge, DTR and deferred tax. However the Companies Act 1967 (Sch2.7A,12(1)(c)), and SSAP8 (issued Nov.1974) required separate disclosure of these items where significant, and these numbers are disclosed separately on Exstat and Datastream.

Several things need to be noted in the use of these numbers. First, companies may not disclose short–term tax accruals. One of the companies we spoke to said they accounted for short–term timing differences in the UK tax charge, that is, they accrued tax on events expected to occur in the next tax year, a notable example being redundancy payments, another being dividends from subsidiaries pertaining to the current year. If this is widespread practice, there may be displacement errors of a year in tax estimates. More significantly, the published tax figure is an estimate of an assessment which may not be agreed for many years. Revisions might be disclosed as 'prior–year adjustments' in subsequent years if they were significant or reflected a fundamental change in accounting policy, though this is not a great help to the researcher since the published prior–year tax figure can be an amalgam of revisions relating to several years, and relating to DTR and Deferred Tax as well. However 'normal' revisions are likely to be

combined with the current year tax charge, so the observed series is a mixture of current period estimate and prior–year errors. The researcher's best course may be to assume the mean error through time is zero, though in reality there may be a tendency to overprovide tax. Two of the firms we spoke to admitted conservatism, though did not consider they were likely to overestimate their tax charge by more than five per cent. Disappointingly, none of the four companies we interviewed in depth were able to provide us with systematic ex post figures on revisions.

3.2 Tax information in Balance–Sheet Data

As an alternative to P&L data the analyst might hope to infer the corporate tax position from movements in the Balance Sheet tax liability, or what is the same thing, the 'tax paid' item in the sources and applications of funds statement. In general these are a less promising data source. Companies are required to disclose separately the tax liabilities due within one year. This is the 'current tax' which is collected on Exstat, Datastream and DTI. However 'current tax' is an aggregate of CT, overseas tax, ACT and income tax. To isolate CT, we need a model of the other three. We do not have a model of overseas tax. We might be in a better position to model ACT and income tax, collected and borne, were it not for the system of 'accounting return periods'. The company has to pay the excess of receipts over payments of these items to the Revenue at the end of each quarter and if the company's year–end does not correspond to with a quarter–end this defines a fifth 'quarter'. So 'current taxation' will show unpaid ACT from the previous quarter. Under SSAP8, however, the company also has to show in 'current tax' the ACT on proposed dividends. To model the ACT and income tax elements we therefore need dated information on receipts and payments. The accounts do not generally provide this for interest, and though it is available for dividend payments this is not collected in databases. An additional problem for modelling income tax is that not all interest is unfranked. For example interest to banks is paid 'gross', but the P&L does not normally

distinguish bank interest. For pre–1965 companies with year–ends between 6 April and 31 December the current year's CT is a long–term liability. Companies are required to disclose this amount and also the date of payment, so this seems to offer an alternative corroboration of the CT charge for some firms. This longer–term tax figure is collected on databases, but it may also contain overseas tax.

4 THE ENTITY IN TAX MODELLING

There is little doubt that the major practical problem facing the tax model builder using accounts data arises because of the difference between the rules for aggregating 'groups' of companies for accounting and for tax purposes, particularly in the case of overseas activities. Though the company is the basic unit both for tax assessment and accounting, we are almost invariably using economic data drawn from group accounts. For research using accounts data the empirically observed entity is the group of companies. This would not be a problem if tax assessments aggregated in the same way as accounting data, i.e. if there were frictionless transfer of tax within groups. The group relief rules mean that amongst UK subsidiaries this is effectively the case, but the identity between tax and accounting treatment may not hold for associates, which are excluded from group accounts but may share some tax pooling under the consortium rules; and for overseas subsidiaries, where the reverse applies. The associate mode of business operation, the accounting manifestation of the joint–venture, is increasingly important. Of the FT100 in 1983, associates provided 5% or more of group profits in 43 cases, 10% in 26, and 20% or more in 13. Overall, income from associates accounted for around 7% of profits before interest and tax for UK firms on the Exstat tape in the 1970's. This rose to 10% during the recession from 1979 to 1982, returning to 7% after 1984. The tax model assumes zero consortium activity; in discussions companies and tax practitioners suggested that this probably does not lead to significant misestimation.

On the other hand the problem raised by overseas activities cannot be ignored. Though published accounts show a split of UK and overseas sales, employees, and tax, earnings and assets are rarely split in this way. So the default, through lack of data is to assume all reported earnings, and assets, UK and overseas, are subject to UK taxation. All of the companies and tax consultants we have spoken to saw overseas activities as the major potential source of misestimation. Table 3 lists three measures of overseas activities.

In King and Fullerton(1984) the unit of analysis is the project rather than the company, so company–level issues like tax exhaustion cannot easily be handled. King and Fullerton recognise this as a limitation and provide a simulation of effective tax rates under the extreme assumption of zero–mainstream in perpetuity. Their main analysis, however, implicitly assumes perfect intra– and inter– company tax transfer markets. In fact, UK revenue law taxes types of income within companies rather than companies. Tax–models not based on accounts data (for example the Inland Revenue model which is based on company tax assessments) may tend to make the other extreme assumption, of zero inter–company tax transfers. This assumption is endemic in macroeconomic modelling also. Goudie (1983) showed the discrepancy between aggregated micro forecasts, and macro forecasts to be significant in forecasting corporation tax liabilities where there is widespread tax exhaustion. This legal formality has no economic significance so long as there is full loss offset within the company. This is generally the case, except for rules restricting the imputation of dividends against overseas and property income (which were described in Chapter 3).

TABLE 4 DIFFERENT MEASURES OF THE OVERSEAS COMPONENT

O/SEAS %	Percentage of Companies by: Sales	Employees	Tax
0	39	81	41
0–10%	14	4	39
11–20%	12	5	13
21–30%	10	5	3
31–40%	7	2	2
41–50%	6	1	1
51–60%	5	0	0
>60%	7	2	1
	100	100	100

Table 4 shows three measures of overseas activity drawn from the accounts of the sample:

1. Overseas sales as a proportion of world sales,

2. Overseas employees as a proportion of world employees,

3. Overseas tax as a proportion of pretax profit.

A zero proportion may signal either a true zero or a missing value. Sales and employees seem to be telling the same story, but with considerably more missing data in the case of employees. In this study we exclude from the sample firms with, on average,more than 40% of their sales sourced overseas in the observation period. For those firms which remain the tax variables were scaled by the non–overseas proportion.

APPENDIX A — UK TAX RATES 1970 – 1990

YEAR		SMALL COMPANIES				CT	CAPITAL ALLOWANCES			
		upper	lower	rate	marg.	rate	w–d	fya		
	basic	limit	limit		rate		plant	build	plant	build
	rate	000's	000's	%	%	%	%	%	%	%
1970	14	–	–	–	–	52	23	04	30	15
1971	39	–	–	–	–	52	25	04	70	30
1972	39	–	–	–	–	40	25	04	100	40
1973	30	40	25	42	17	40	25	04	100	40
1974	33	40	25	42	17	52	25	04	100	45
1975	35	50	30	42	15	52	25	04	100	50
1976	35	65	40	42	16	52	25	04	100	50
1977	34	85	50	42	14	52	25	04	100	50
1978	33	100	60	42	15	52	25	04	100	50
1979	30	130	70	40	14	52	25	04	100	50
1980	30	200	80	40	08	52	25	04	100	50
1981	30	200	80	40	08	52	25	04	100	75
1982	30	200	80	38	08	52	25	04	100	75
1983	30	400	100	30	08	50	25	04	100	75
1984	30	500	100	30	02	45	25	04	75	50
1985	30	500	100	30	02	40	25	04	50	–
1986	29	500	100	29	01	35	25	04	–	–
1987	27	500	100	27	01	35	25	04	–	–
1988	25	500	100	25	01	35	25	04	–	–
1989	25	750	150	25	01	35	25	04	–	–
1990	25	750	150	25	01	35	25	04	–	–

APPENDIX B EXSTAT DATA

This table shows the construction of economic variables not otherwise mentioned earlier, and the definitions of Exstat codes.

FIXED ASSETS:	
property	= C83 + C84
plant	= C87 + C88
new leased assets	= C147 – C147(–1) + CE4 – CE4(–1)
additions in the year	
– property	= CC3 + CC9
– plant	= CC11 + CC17 – CC67
disposals in the year	
– property	= CC4 + CC5 + CC6
– plant	= CC13 + CC14
STOCK	= C102 + C103 + C104
DEBTORS	= C106 + C109
CASH AND INTEREST–BEARING DEPOSITS	= C110 + C111
OTHER LIQUID ASSETS	= C108 + C110
TOTAL ASSETS	= C115
SHAREHOLDERS FUNDS	= C132 + C133 + C134
LONG–TERM DEBT	= C136 + C137 + C138 + C139 + C140 + C141
SHORT–TERM DEBT	= C148 + C149 + C150
CREDITORS	= C151
TAX PAYABLE	= C153
DIVIDEND PAYABLE	= C154

DEFINITIONS OF EXSTAT CODES USED

BI	Issue code
B29	Number of periods for which data held
B31	End date of first period for which data held
B32	End date of last period for which data held
C1	Issuer code
C2	Period end date
C8	Period duration
C31	Sales/Turnover
C32	Associated companies' profit share
C33	Other income
C34	Profit before tax
C35	Corporation tax amount
C36	Corporation tax rate
C37	Deferred tax (tax equalisation)
C38	Overseas tax
C39	Double tax relief
C47	Cost of preference dividends/cost of other dividends
C52	Depreciation and amortisation
C53	Short–term interest
C54	Long–term interest

C55 Other interest

C83 Property at valuation
C84 Property at cost
- CC3 Additions
- CC4 Disposals
- CC5 New subsidiary companies
- CC6 Subsidiary companies disposed of
- CC7 Revaluations
- CC9 Other

C85 Accumulated depreciation and amortisation (property)
C87 Other tangible assets at cost
C89 Accumulated depreciation and amortisation (other tangible assets)
- CC11 Additions
- CC12 Disposals
- CC13 New subsidiary companies
- CC14 Subsidiary companies disposed of
- CC17 Other

C102 Stock–raw materials
C103 Stock–finished goods
C104 Work in progress
C105 Total stock and work in progress
C106 Debtors
C108 Quoted investments (current)–book value
C109 Bills receivable
C110 Other investments, deposits, etc.
C115 Total assets

C132 Shareholders' funds
C133 Minority interest
C134 Deferred tax (tax equalisation)
C136 Debentures – parent companies
C137 Debentures – subsidiary companies
C138 Loan stocks/all obligations, bonds, notes, etc. of a special nature – parent Companies
C139 Loan stocks/all obligations, bonds, notes, etc. of a special nature – subsidiary companies
C140 Bank loans
C141 Other loans
C147 Other creditors due after more than one year (UK companies)
C148 Bank loans and overdrafts
C149 Acceptance credits
C150 Short–term borrowings
C151 Creditors
C153 Current taxation/duties and taxes
C154 Proposed dividends

CA4 Overseas sales/turnover
CB2 Investment income

APPENDIX C THE TAX AND ACCOUNTING TREATMENT OF GROUPS

Though the company is the basic unit both for tax assessment and accounting, in estimating tax positions as outsiders we are almost invariably dealing with group accounts. This would not be a problem if tax assessments aggregated in the same way as accounting data, i.e. if there were frictionless transfer of tax within groups. The rules for transferring tax liabilities within groups depend on the nature of the group, and different possibilities are open if subsidiaries are 50% owned, 75% owned, or part of a consortium. In 75% groups, losses in one group member can be offset against total profits of the group in the same or previous period, or carried forward against profits of the same trade, but 'diagonal' offsets against total profits in future periods are prohibited. Hence losses bought in a new subsidiary often have to be carried forward within that subsidiary. This accounts for the phenomenon which users of accounts sometimes find confusing of apparently taxpaying companies carrying forward tax losses. Besides 'group relief' other tax reliefs are available to members of a group. In 50% groups, intergroup payments of interest and dividends can be made without income tax or ACT being deducted, and surplus ACT can be surrendered by parents to subsidiaries. Assets can be transferred within the group without attracting capital gains tax, and gains made in one subsidiary can be rolled over against another's acquisitions. These rules apply to UK resident subsidiaries only, but among such companies the rules seem to permit fairly free transfer of tax liability. However, there are two other important classes of company, overseas subsidiaries, which are accounted for as group members but only have limited tax pooling, and 'associates' which are not accounted for in the group, but may have some tax pooling privileges.

C.1 Overseas Companies

The ability to transfer tax liability between overseas and domestic group members is severely limited. A series of double–tax treaties dictate the extent to which overseas tax

borne on dividends remitted by overseas subsidiaries can be used to offset UK corporation tax. Hence the only way that overseas losses can be relieved is through instruments such as transfer–pricing whose use is heavily restricted by anti–avoidance rules. As we will see, the diversity of overseas tax laws also poses a major problem for tax model–building. Even if we could model the various tax regimes affecting the firm we do not have sufficient data to apportion earnings, investment and so on, between them.

C.2 Associates

In accounting, the treatment of related companies depends on the degree of ownership. If a company is less than 20% owned, the 'group' accounts (using the word 'group' loosely for a moment) show as income only the dividends received, and in assets only the cost or valuation of the shareholding. If ownership is between 20% and 50% the company is an 'associate' and under SSAP 1 the owned proportion of its income statement and of its reserves are shown in the group accounts. If ownership is more than 50% then group accounts are prepared under SSAP 14, and the whole of the subsidiary's assets and liabilities and its income is shown in the group accounts and the share belonging to minorities is shown as a liability. Under tax rules, however, some group reliefs are available to certain consortia. A company is 'owned by a consortium' if all of the ordinary share capital is owned directly and beneficially by 5 or fewer resident companies, and joint–ventures which exploit these tax rules are used by some firms, with the result that unconsolidated income may attract loss relief.

CHAPTER 5

ESTIMATES OF EFFECTIVE CORPORATE TAX RATES FOR UK COMPANIES

This chapter reports the incidence of tax exhaustion amongst UK industrial and commercial companies between 1973 and 1988. Estimates of tax resumption lags and effective corporate tax rates are provided at the company level. By 1980 over 40% of UK companies were not paying corporation tax, and more than 70% had surplus dividend tax credits. The implied median effective tax rate in the most tax exhausted industries was only half the statutory rate. Expected tax rates, conditional upon the future process in earnings and on the tax regime, are also estimated and point estimates are produced of the mean and variance of companies' effective tax rates.

1 INTRODUCTION

This chapter reports the incidence of tax exhaustion amongst UK firms during the 1970's and 1980's and estimates tax resumption dates and effective corporate tax rates for individual firms under different assumptions on expectations.

Tax rules permit companies with tax losses to carry them forward to reduce future taxable profits. The marginal unit of income or expense of such firms is only taxed when the firm resumes taxpaying and if it becomes chronically 'tax exhausted' this tax deferment can radically change the incentives for investment in real assets and for financing. The introduction in the early 1970's of 100% first–year tax write–offs for plant and machinery and, in 1974, of tax relief on inventory inflation, combined with historically low corporate profits, meant that many UK companies were generating tax losses by the late 1970's and early 1980's. Opportunities to arbitrage these tax losses were limited (Cooper and Franks(1983)) and some companies became tax exhausted for

extended periods. This was not solely a UK phenomenon, and a similar picture was found in the US, Japan, and elsewhere. In an imputation tax system like that of the UK tax exhaustion can arise on two levels: firms may have tax losses (or in UK parlance be 'mainstream' tax exhausted) and moreover they may have surplus dividend credits (be 'ACT–exhausted'). Both of these affect the firm's marginal effective tax rate. Tax exhaustion in the UK abated in the mid 1980's, partly due to the 1984 Lawson budget which withdrew some important tax subsidies and partly as a result of the improved profitability of UK companies. The incidence of ACT–exhaustion declined too, though there remained a significant number of firms in this position throughout the 1980's, including many UK multinationals.

Several studies have provided estimates of the incidence of tax exhaustion in the UK.[1] The present chapter makes the following contributions to this literature. Firstly a more detailed and comprehensive analysis of the incidence of tax exhaustion is provided than has hitherto been available. This analysis uses annual data for 999 UK companies during the period 1972 to 1988, comprising the major part of the output of the UK industrial and commercial sector. The sample embraces quoted companies, but also larger unquoted firms including state enterprises and the UK subsidiaries of foreign multinationals. The sample is thus more comprehensive than any used in previous work. Second, tax resumption lags and thus an effective tax rate are estimated annually for each company. These are estimated first on the basis of the company's actual experience of tax resumption and on the future outturn of tax rates, and second as an expected rate, on the assumption that earnings evolve stochastically and that subsequent changes in tax rules are unknown.

The chapter proceeds as follows. Section 2 introduces the main ideas by developing an

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[1]See Devereux(1987b), Edwards, Mayer, Pashardes and Poterba(1985). This chapter updates and extends the results in Higson(1986).

expression for the effective tax rate under UK imputation tax rules. Section 3 describes the empirical methodology used for forecasting tax resumption lags and for estimating effective tax rates. Section 4 describes the data used for this study and the method of sample selection. Section 5 presents estimates of the incidence of tax and ACT exhaustion in the UK in the 1970's and compares them to existing results in the literature. Section 6 presents estimates of tax resumption dates and of effective tax rates for quoted companies. The final section draws the conclusions of the chapter.

The main findings of this chapter are as follows. By 1980 over 40% of UK companies were not paying corporation tax, and more than 70% had surplus dividend tax credits. The implied median effective tax rate in the most tax exhausted industries was only half the statutory rate, and if the 1984 tax reforms were unanticipated the expected effective tax rates were lower still. Whilst confirming existing estimates of the incidence of mainstream exhaustion amongst quoted companies, the results of this paper suggest that the extent of ACT exhaustion has been understated in the existing literature. This is significant since, at the tax rates which have prevailed in the UK, the firm's ACT position is the major determinant of its effective tax rate. Companies which survived over the whole period were more likely to be taxpaying than companies with a shorter history on the database, suggesting a risk of survivorship bias in empirical estimates of tax positions, and quoted companies were more likely to be taxpaying than unquoteds including UK subsidiaries of overseas multinationals, and utilities. Finally, stochastic simulation demonstrates that marginally taxpaying companies had a much higher variance of effective tax rates than fully taxpaying or deeply tax exhausted companies.

2 THE EFFECTIVE CORPORATE TAX RATE UNDER UK IMPUTATION TAX RULES

The main idea behind this chapter is the effective corporate tax rate[2]. Define the effective corporate tax rate, τ_t^*, as the value at t of the incremental corporate tax cash flows associated with a unit of taxable cash flow at t. The effective tax rate is a marginal rate which differs from the statutory rate because of payment lags. Even for a fully taxpaying firm there is a statutory lag between the taxable event and the tax payment date[3], but payment lags lengthen considerably when the firm has insufficient taxable capacity to absorb its tax deductions. If a UK firm has tax losses these can be carried back against taxable profits of the previous year[4], and forward without limit against the profits of the same trade. The firm with carried–forward losses will not resume paying corporation tax until its stock of tax losses is used up and the marginal cash flow will not therefore be taxed until the firm resumes taxpaying, so its effective tax rate on the marginal cash flow would be

$$\tau_t^* = \tau_{c,t+p}\cdot(1+r)^{-(s+p)} \tag{1}$$

where $$p = \text{MIN}[p] \text{ s.t. } 0 < \sum_{t-1}^{t+p}(X_t) + L_{t-2}$$

and where taxable profits are determined from

$$X_t = X_t(X_{O,t}, I_t, S_t, R_t; \varphi_t)$$

here, τ_t^* = effective corporate tax rate
τ_c = statutory corporate tax rate
p = tax resumption lag
s = statutory tax payment lag
X_t = taxable profit, before loss relief

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[2]In this paper we consciously limit attention to corporate taxes rather than investor taxes to focus on tax exhaustion. Hence we abstract from clientele issues. For a discussion of these issues in a UK context see Mayer(1986) and Higson(1990).

[3]In the UK companies pay tax 9 months after their accounting year–end, that is, 15 months after the average taxable event in the year.

[4]Three years since fiscal year 1991.

L_t = losses carried forward at t

r = discount rate for tax payments

$X_{O,t}$ = operating profit, gross of depreciation, plus other income

I_t = investment in plant and in buildings

S_t = inventories

R_t = interest paid and received

φ_t = tax rules for period t earnings

Equation (1) defines the effective tax rate for a classical tax system but in the UK imputation system there is another source of tax exhaustion, where the firm has surplus dividend credits. When it pays a dividend the firm must make an 'advance corporation tax' (ACT) payment[5] of:

$$ACT_t = D_t.\tau_m/(1-\tau_m)$$

where D_t is the dividends paid, net of dividends received in period t, and τ_m is the rate of imputation, which in the UK is the basic rate of personal income tax. ACT payments provide the firm with a credit against corporation tax (CT), the balance being known as 'mainstream', and provide the shareholder with a credit against personal income tax. However the credit against corporation tax is limited to the ACT on a full distribution of the company's UK taxable income, net of losses. If X_t^L is UK taxable income net of loss offset the maximum ACT offset is $X^L.\tau_m$ leaving a wedge of mainstream, $X^L(\tau_c-\tau_m)$, which must be paid even if there is unrelieved ACT. In a 'full' imputation system $\tau_c=\tau_m$ and the wedge is zero, whereas the UK has a partial imputation sytem, with $\tau_c>\tau_m$[6]. Unrelieved ACT can be carried back up to 6 years (pre–1983, 2 years) and forward indefinitely. If the period of carry–back is b, and assuming for convenience there was no stock of unrelieved ACT carried forward at b–1, the lag before the firm can relieve an incremental unit of ACT, q periods, is

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[5]Payable within 3 months of the dividend payment.

[6]In the UK full imputation applies to smaller companies which have a lower rate of corporation tax such that $\tau_c=\tau_m$.

$$q = \text{MIN}[q] \text{ s.t. } 0 < \sum_{t-b}^{t+q} [X_t^L - D_t/(1-\tau_m)]$$

Hence surplus dividend credits provide a second source of tax–exhaustion under the imputation system of taxation. Even if the firm has a corporation tax liability (p=0) this may be insufficient for it to impute all the ACT on its dividend payments. An incremental unit of taxable cash flow relaxes this constraint, so the effective tax rate in an imputation system is[7]:

$$\tau_t^* = \tau_c(1+r)^{-(s+p)} - \tau_m[(1+r)^{-(s+p)} - (1+r)^{-(s+q)}] \quad (2)$$

Equation (2) assumes of course that the marginal taxable event has no incremental effect on dividends. An alternative assumption might be that incremental taxable profits are fully distributed, and expenses reduce dividend by 100%. This sort of specification emerges naturally from analysis using a dividend valuation model where the full distribution assumption is usually implicit (see chapters 2 and 3 for a fuller discussion of these issues) and in this case there will be a lower bound of τ_m on the effective tax rate of a fully tax exhausted firm (see, for example, Keen and Schiantarelli (1988)).

The difference between the imputation and the classical versions of the effective tax rate is that in (2) a unit increment of taxable income permits the firm to bring forward the recovery of τ_m of imputation credits from q to p. If $p = q \geq 0$, perhaps because the firm does not pay a dividend or is not tax exhausted (2) reduces to (1). These rates are partial tax rates in the sense that they are specified only in terms of tax effects on the company, and personal tax rates of investors do not enter the expression. However, though they are analogous to effective tax rates which emerge from an equilibrium model of the firm's financing decision there is no particular presumption of equilibrium in the present

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[7]From now on constant τ_c, τ_m are assumed.

chapter. Indeed as will be seen below the diversity of effective tax rates which is observed in practice is inconsistent with existing unconstrained equilibria in the literature.

Another way to interpret the imputation effective rate emerges from rearranging (2) to give

$$\tau_t^* = [\tau_c - \tau_m](1+r)^{-(s+p)} + \tau_m(1+r)^{-(s+q)}$$

The imputation effective rate has two components: a wedge, the excess of the corporation tax rate over the imputation rate, collected when the firm resumes mainstream; and the imputation rate, collected when the firm can relieve ACT. In the limit where the firm is fully tax paying but has permanent unrelieved ACT (p=0, q=∞, and assume s=0), then $\tau_t^* = \tau_c - \tau_m$. In the years 1980 and 1990 the effective tax rates faced by UK firms in the 'corner' tax positions: 1. fully tax paying, 2. tax–paying but permanent unrelieved ACT, 3. permanent non–taxpaying, were (ignoring statutory payment lags):

	a 1980	b 1990
1. Full tax paying	52%	35%
2. Unrelieved ACT	22%	10%
3. Non Taxpaying	0%	0%

Clearly, even when the wedge was quite large, for instance, pre–1984 when the corporate rate was 52% and the imputation rate was 30%, q rather than p was still the major determinant of the effective tax rate. The policy issue, pre–Lawson, was the number of firms in category 3a and the difference between the effective tax rate facing these firms and that facing full tax payers. But in 1990 there remained a significant number of companies in category 2; firms with unrelieved ACT, including an increasing number of multinational companies. In extremis, these companies face an effective tax rate of only 10%.

3 EMPIRICAL METHODOLOGY FOR ESTIMATING EFFECTIVE TAX RATES

At each date, t, the duration of nontaxpaying (p), and of unrelieved ACT (q) were estimated annually for each firm, up to a horizon of 1998. This generated predicted tax cash flows, and these were discounted to produce the implied effective tax rates at t. To estimate tax resumption dates requires each company's initial stock of tax losses and of unrelieved ACT at each date and forecasts of the subsequent evolution of its tax generating variables: profits, investment, dividend policy and so forth and of the tax rules which would apply in subsequent periods. The tax generating variables were forecast using a simple model of the company's cash flows, the 'company model', which is described below. The forecasts were made on two quite different assumptions about expectations: that the firm has perfect foresight of its future profits, and alternatively that a stochastic process generates profits and the firm knows only the parameters of the process. Tax liabilities were estimated from the forecast tax generating variables using a detailed company level model of the UK tax system[8]. Companies do not systematically disclose accumulated stocks of tax losses so these too were estimated from historic data using the tax model.

3.1 The Company Model

The level of gross (of depreciation) operating profit, X_O, determines the other tax generating variables, subject to a funds identity:

$$0 \equiv X_{O,t}+\Delta E_t+\Delta B_t-I_t-\Delta S_t-\Delta C_t-T_{t-1}-R_t-D_t$$

where, additionally

E_t = Equity, ΔE = new issues of equity
B_t = Borrowing, net of cash and interest–bearing deposits
C_t = Net trade credit given
T_t = Corporation tax payments (mainstream + ACT)

[8]For a detailed description of the operation of the company tax model see Chapter 4

Both financial and real variables, with the exceptions noted below, follow their historic average proportionate relationships to gross operating profit, which is defined as gross operating profit plus income from associates, rentals and other income, and which approximates operating cash flow plus other income. Hence these variables are parametric given the forecast of profits. The historic relationship is estimated using all available historic data for the firm. For variables normally assumed to be turnover dependent, such as the stocks, sales was estimated from gross operating profit by assuming the firm maintained its historic margin on sales. This modus operandi may appear unconventional from the point of view of corporate modelling, which more conventionally proceeds by forecasting sales and forecasting the firm's ability to achieve its margin. It is because the necessary data for modelling of this sort is not available that forecasts were driven by macro economic forecasts of earnings. Specific components of the funds identity were modelled as follows:

– Investment in fixed capital, buildings and plant was assumed to take place at the company's historic average propensity to invest from gross operating profit. Accounting depreciation, when needed, was calculated by applying the company's historic depreciation rate to this augmented capital stock.

– Inventories and 'net trade credit given' are at the company's historic ratios to sales. The aggregate UK stock/output ratio is known to have declined secularily in the 1980's so forecasts were adjusted for this secular decline post–1979 (see Higson(1987b)).

– Dividends were modelled using a model in which dividends adjust with a lag to a target payment level.

– Net interest payments were calculated at the t–bill rate plus a premium of 1% on net borrowing, and were lagged one year.

– The stock of other financial assets is held constant in real terms in the funds identity, as is equity in the first instance. The funds identity is balanced by borrowing, though the firm issues equity to maintain its historic leverage ratio as an upper bound on borrowing.

3.2 Assumptions for forecasting

3.2.1 Perfect Foresight First it was assumed that the firm has perfect foresight about the evolution of its tax generating variables and about the tax rules. Actual data on the variables that generate tax liability were read from the company's accounts for years up to 1988 and were estimated thereafter off a single–valued forecast of earnings by applying a firm model, described below, in which all of a company's other economic magnitudes are functionally related to earnings. These data were fed through a model of the UK corporation tax system (see Chapter 4) assuming actual tax rates and rules until 1990, the date of the study, and that the 1990 tax rates and rules persisted thereafter.

For forecasting earnings after 1988 a submartingale[9] process was assumed in which operating profit, $X_{O,t}$, was forecast as $X_{O,t-1}$, inflated by the forecast aggregate growth rate in firm gross profits from the LBS macroeconomic model until 1994 then with a steady state thereafter. Forecasting off an aggregate growth rate breaks down when firms have negligible or negative gross operating profits in the previous period. Roughly 10% of UK companies have been in this position in any year. For these firms estimates were generated from a mean regressive process whereby they would return, perhaps by merger or internal means, linearly over the following five years to the average level of profitability for their industry.

Tax liabilities estimated from accounting data are subject to error which may be cumulative and significant. For instance, tax allowances depend on the detail of type and location of assets and earnings and these may be poorly proxied by published accounting

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[9]While some researchers have used time–series modelling to forecast earnings from accounts data (Devereux(1986)), there is little evidence that companies' historic annual accounting data contains useful information on their future trajectory, the main empirical result being randomness in both the absolute and deflated profit series. In summarising this literature, Foster(1986) quotes Albrecht, Lookabill, and McKeown(1977) 'We found little difference in the predictive accuracy of the random–walk model and the best–fitted Box–Jenkins models'

data (Higson and Holly(1990)). But companies disclose their UK corporation tax liability and often disclose tax loss carryforwards also. The former is available on the Exstat tape, while the tax loss data was collected by searching the accounts on microfiche of companies in the sample. The published corporation tax data and, where available, the tax loss data was used in preference to model data over historic periods where model data was inaccurate.

3.2.2 Stochastic Perfect foresight has usually been assumed in existing work. Perfect foresight effective tax rates describe the actual experience of firms and are of interest from a public policy standpoint in describing the ex–post marginal burden of taxation. However they have two limitations for empirical work. They may not describe the expectations of the firm about its effective tax rate, and they do not reflect the uncertainty associated with those expectations. Hence estimates were also made on the assumption that the firm is myopic and forms expectations about the effective tax rate conditional on a stochastic process in earnings.

The company's expectation at time 0 of the effective tax rate on taxable cash flows at that time has the form:

$$E_0[\tau^*] = \underset{t=0\rightarrow n}{E}[I_t, S_t, R_t, D_t; \tilde{X}_t; \varphi_t],$$

The expected tax rate depends on expectations about the tax generating variables: operating earnings, investment, stockholding, interest and dividend payments, and on the prevailing tax rules, φ_t, up to the firm's planning horizon, n. The assumption that operating earnings drive the other tax generating variables is maintained, but it is now assumed that the firm is uncertain about operating earnings and future tax rules. Expected tax rates were estimated assuming that subsequent operating earnings were generated from a random–walk proxied by the following binomial process:

$$X_{O,t} = (X_{O,t-1} \pm \sigma).g_t$$

where σ is the company's historic standard deviation of real operating profit. g_t is forecast growth in the aggregate nominal operating profits of UK industrial and commercial companies, which ignoring the cross–product term can be interpreted as the sum of real growth, g', and expected inflation, i. Each year this process implies 2^n independent earnings paths to an n–year horizon. The company model and the tax model were used to estimate an effective corporate tax rate over each path, and the expected tax rate was estimated as the arithmetic mean of these rates. In this paper rates were estimated from 16 paths, with a steady state assumed along each path after 4 years.

Stochastic effective tax rates were initially estimated on two sets of assumptions, first that the firm knows its current period's earnings but not next period's, and second that the firm is uncertain even about its current period's earnings. Such myopia has been posited by, for example, DeAngelo and Masulis(1980) whose firm invests continuously during the year, but earnings and thus tax position are not revealed until the year end. Whilst this extreme myopia was necessary for the attainment of the DeAngelo and Masulis equilibrium it has only partial realism in the context of a modern firm, which is able to monitor its operations continuously though which, since tax is not collected continuously, may be vulnerable to a negative variance late in the year which may retrospectively determine the effective tax rate applied to earlier investments.

3.2.3 The Assumptions about Behaviour.

A number of assumptions are being made in forecasting tax cash flows. Two alternative assumptions are made on the firm's forecasting ability, first that the firm has perfect foresight of the evolution of its tax position, and second that the tax position evolves stochastically. Simulations are also run, later in the chapter, of the effect on tax rates of

different assumptions about future statutory tax rates. In the UK over this period it is important to consider the effects of 'unanticipation' of the Lawson tax system reforms in 1984. In all the estimates it is assumed that the tax generating variables evolve independently of the company's tax position. This assumption, which is made also in the bulk of previous UK work in the area, requires comment. The impact of this assumption in the present work is rather more limited than in other studies because in the perfect foresight model, where available, actual rather than modelled tax data are used to estimate effective tax rates. In this case assumed paths of the tax generating variables affect effective tax rates in the case of those firms, around 10% of the total, which are still tax exhausted in 1988. To the extent that these firms modify real and financial policies in response to their tax rates, these rates may underestimate outcome rates. This should be understood when interpreting the tax positions reported later. The approach seems reasonable when the emphasis is on describing company tax positions, especially since successful empirical models of tax influence on real and investment behaviour are in very short supply in this area. However when the tax rates are being used as an input to the estimation of a tax influence model it is possible to reestimate effective tax rates under different assumptions about future investment and financing behaviour.

In the final section of the paper the relationship between effective tax rates and expected future tax rates is investigated directly. The non–linear nature of the tax function in a world where there is carryback and carryforward of tax losses is modelled by stochastic simulation. Earnings evolve as a random walk, and for a given margin we assume other tax–generating variables, dividends and investment, are determinate. The present effective tax rate is the arithmetic mean of the tax rate along each path, and replicates the call option structure of the government's tax claim emerges because taxable profit is non–positive along some paths.

3.3 The discount rate for tax payments

The question of whether to discount risky tax payments at a riskless rate reflecting the contractual nature of the tax liability, or at a risky rate reflecting the economic uncertainty in taxable income has generated much debate, but since corporation tax is a contingent claim with the structure of a complex call–option there is in principle no method of valuing its associated uncertainty using a risk premium. As Majd and Myers(1985) put it "as a practical matter any adjustment to the discount rate is just a fudge factor". Consider the Revenue's total claim on the earnings of the company in a simple classical world with no carryforwards and immediate tax payment. Because taxation is asymmetric the government's tax take in any period is:

$$T_t = \tau_{c,t}.MAX[\tilde{X}_t, 0]$$

Effectively the government holds a portfolio of τ_c call options on period t taxable earnings, and the marginal tax rate is τ_c or 0 as $\tilde{X}_t \geq 0$, or $\tilde{X}_t < 0$. However with carryforwards the government's claim in any future period t+x is

$$T_{t+x} = \tau_{c,t+x}.MAX[\tilde{X}_{t+x} - MIN[\sum_{t}^{t+x-1} (\tilde{X}_t) + L_t, 0], 0]$$

where L_t is the brought–forward stock of losses at t. The value of the government's tax claim on each period is no longer independent of other periods. The marginal tax rate implied by this expression was defined in equations (1) and (2), in terms of the first–passage of the stock of losses through the zero boundary. In general it is only feasible to solve this first–passage problem numerically because of the interdependency just mentioned – the state variable L_t is revised by subsequent realisations of X. In an imputation tax system the government's tax claim is also dependent on the first passage of the stock of unrelieved ACT. So closed–form option valuation models (Galai(1983), Green and Talmor(1983), Franks and Pitts(1985)) are likely to have limited value in this context.

In the stochastic estimation the risk in the expected tax rate was evaluated directly by discounting tax payments at the risk–free rate, and simulating the stochastic process in taxable earnings. Majd and Myers(1985) used a similar proceedure to value the tax claim at the level of the project, in their case using Monte Carlo simulation to generate the effective tax rate on a non–marginal project undertaken by firms with different degrees of tax exhaustion.

In calculating the perfect foresight effective tax rate, tax payments were discounted at an 'equity' rate, as the t–bill rate plus a 9% risk–premium, which is the historic average after tax market risk–premium in the UK (see Brealey(1990)).

4 DATA AND SAMPLE

The database for this study is the Exstat tape, which records published accounts data for firms that are quoted industrial and commercial companies or are in the Times 1000. The earliest year of data on the tape is 1972, and the latest available data at the time of the study was in most cases 1988[10]. The composition of the Exstat population changes annually as firms enter, or exit because of merger, failure or ceasing to meet the inclusion criteria. As is common in economic research using firm data, previous work on tax exhaustion has tended to use samples comprising balanced panels of companies which 'survive' over the whole research period. The preference for a balanced panel arises because many statistical packages are inconvenient to use with unbalanced panels. Tax researchers are attracted to companies which survive over the whole period because this work usually requires estimates of non–published economic magnitudes such as stocks of tax losses and of unrelieved ACT, and this can only be done by cumulation over extended periods. The quality of the estimates is believed to be enhanced the longer the estimation period. However there is a real risk of bias in using balanced panels of survivors. For instance the coverage of the Exstat tape was significantly extended in 1976 to include a large tranche of smaller firms, while at the other end the mid to late 1980's witnessed considerable attrition in the population through takeover.

In this study, the requirement for a rectangular or balanced panel was removed by using the package DPD, which tolerates an unbalanced sample. Further, length of survival was traded off against breadth of sample, and a minimum survival requirement was imposed of the eleven year period 1976 to 1986. This starting date coincides with the expansion of

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[10]Since corporation tax is assessed on accounts years and in the UK companies may choose any year–end date, we adopt the convention of aggregating data in the fiscal years in which the accounts year ends. Typically about 40% of large UK companies choose December year–ends, 20% choose March and 10% choose September (Barron(1985)). To avoid misclassification (see Barron) a mid–month cut–off is used. Hence '1980' includes year–ends between 16th April 1980 and 15th April 1981. Inland Revenue statistics are also aggregated on a fiscal year basis.

the database in 1976 and predates the most intense period of tax exhaustion, while the closing date embraces the 1984 tax reform but only overlaps the earlier part of the merger wave of the 1980's. Two further restrictions were imposed on the sample: financial and property companies were excluded, and because of their particular tax regime, oil companies. Exhibit 1 reveals the survivorship pattern of the Exstat tape by investigating the prior history of the 1745 companies on the tape in 1985, and the subsequent history of the 1602 companies on the tape in 1976. Two starting dates 1972 and 1976, and two closing dates, 1986 and 1988 are suggested. Exhibit 2 describes the composition of the sample which was constructed within the restrictions and which survived within the four groups suggested by these dates. The sample contains 999 industrial and commercial companies. 73% of this sample by number are UK listed companies, 15% are UK subsidiaries of foreign corporations, and 12% are UK unlisted. Four of the sample are the major public utilities; coal, railways, posts and electricity. Despite its small number this group is economically significant, accounting for 11% of the turnover of the sample in 1980. Table 1 relates the sample to aggregate statistics for the UK. The sample as a whole accounts for over 80% of UK output in terms of profits.

EXHIBIT 1 STRUCTURE OF THE EXSTAT POPULATION

This exhibit indicates the survival attributes of companies on the Exstat tape. Panel a) shows the entry dates of the 1745 companies still on the tape in 1985, and panel b) the exit dates of the 1602 companies on the tape in 1976.

a) The number of companies which were on the tape in 1985 and joined the tape in the each of the following years:

1971	1972	1973	1974	1975	1976	1977	1978	TOTAL
738	170	17	17	111	396	189	107	1745

b) The number of companies which were on the tape by 1976, and left the tape in each of the following years

1983	1984	1985	1986	1987	1988	TOTAL
68	85	108	115	182	1044	1602

TABLE 1 SAMPLE PROFITS AS A PROPORTION OF AGGREGATE

This table shows aggregate profit before interest, tax and depreciation for the sample, compared to UK Central Statistical Office data for industrial and commercial companies, including oil companies and income from abroad, which is net of depreciation and taxes.

Year	Sample	Aggregate	Sample/ Aggregate %
1972	8184	10490	78
1973	11669	14062	82
1974	15730	16381	96
1975	14969	16268	92
1976	21310	20790	102
1977	24137	25919	93
1978	25813	29756	86
1979	33181	40010	82
1980	31732	40239	78
1981	33390	43242	77
1982	38374	47606	80
1983	47424	55523	85
1984	59701	65171	91
1985	65357	72585	90
1986	58991	67317	87
1987	69826	81617	85
1988	71827	93252	77

EXHIBIT 2 COMPOSITION OF THE SAMPLE

Panel a) cross–tabulates the populations of industrial and commercial companies for key dates. Two starting dates, 1972 and 1976, and two closing dates, 1986 and 1988 are suggested, and panel a) further suggests that four data blocks involving these dates achieve a balance of length and breadth. Panel b) decomposes the sample into four survivorship groups. Panel c) shows the composition of the sample by ownership type.

a) Number of industrial and commercial firms in each age group

	Exited	1988 or later	1987	1986	
Entered	**1972 or before**	525	60	38	
	1975	64	25	8	
	1976	218	44	17	Total 999

b) Number in each survivorship band

1972 – 1986	98	
1972 – 1988	525	
1976 – 1986	94	
1976 – 1988	282	Total 999

c) Composition by type

	number		total sales (bn)		average sales in 1980 (mn)
		%		%	
quoted	728	73	11.8	62	16.2
overseas subsids	152	15	2.7	14	18.0
unquoted	115	12	2.5	13	22.1
public utilities	4	0	2.0	11	505.0
	999	100	19.0	100	19.1

5 RESULTS: LEVELS OF TAX EXHAUSTION AND ACT EXHAUSTION

5.1 Evidence from accounts data on tax exhaustion in the population

The annual charge for corporation tax, though not the ACT liability, is reported by all companies in their accounts so provides information on the incidence of tax exhaustion in the population as a whole. Table 2 shows the percentage of all industrial and commercial companies on the Exstat tape with a zero corporation tax charge each year[11]. In this population tax exhaustion reached a peak in 1980 when over 47% of UK corporations were non–taxpaying (column a). The number of non taxpayers jumped sharply in 1974, when stock relief was introduced, and rose steadily to 1980; it declined sharply after 1983, to just over 11% by 1989.

One reason why it may be misleading to use the published UK corporation tax charge as an indicator of tax exhaustion is that many companies which are basically non–taxpaying will contrive sufficient UK tax liability to absorb their double tax relief (DTR), which is a deduction that cannot be carried to other years. So Table 2 also reports the percentage of firms with a zero CT charge after netting reported DTR against the reported corporation tax charge. This adds 2% to the number of non–taxpayers in most years (column d).

The present study attempts to minimise the impact of the survivorship constraint on sample selection by only requiring survival over the period 1976 to 1986 but there clearly remains a significant difference between the taxpaying experience of firms which do and do not 'survive' on this definition. Columns b and c (e and f for the ' net of DTR' case) divide the population of nontaxpayers into survivors and non–survivors. With the exception of the peak year 1980, when the proportions converge, the incidence of non–taxpaying was around 6% less in survivors than non–survivors between 1974 and 1983.

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[11]Where there were tax repayments they were treated as 'anticipated' and carried back one year to reduce the previous year's tax payment.

This survivorship effect appears to be associated with the fact that survivors tend to be the larger firms. Columns g and h split the population into small and large firms where 'large' means with sales of over #50 mn at 1984 prices. Between 1976 and 1985 about 8% more small firms were tax exhausted than large firms in any year. This might be expected if group relief within large, diversified firms offer a less costly opportunity for trading tax capacity than is available through the market place.

Another restriction imposed on the sample is the exclusion of companies with significant overseas income. Table 2 shows that 'overseas' firms have a significantly lower incidence of tax exhaustion in most years.

Though the surviving group of quoted firms, which is the research population in most studies, account for the greater part of UK industrial and commercial output the data in Table 2 suggest that results from survivor studies do not transfer to the rest of the population.

5.2 The incidence of tax exhaustion in surviving firms

Table 3a shows the annual percentage of companies in the (survivor) sample with zero mainstream both on an equal weighted and size weighted basis, using sales as a measure of size, from 1973 to 1988. Whilst arguably from a public policy perspective the size weighted depth of tax exhaustion is most significant the equally weighted results are informative about the distribution of tax exhaustion in the economy. Tax exhaustion deepened through the 1970's until in 1980 and 1981 well over 40% of UK companies on a size weighted basis were not paying mainstream corporation tax. The number of tax exhausted firms halved between 1983 and 1986, and was forecast to fall below 10% in 1990.

These estimates suggest that tax exhaustion was rather deeper in the early 1980's than has previously been reported (Higson (1986), Devereux (1987b)) and it is important to understand why this is so. First, the estimates assume perfect foresight, so that tax losses which emerge in year t are carried back to reduce tax payments in t–1 if these are positive. This assumption is significant and entirely accounts for the higher incidence of tax losses reported for all firms on an equally–weighted basis in Table 3a, say, than the comparable column i of Table 2 (55% as against 47% in 1980 on an equal weighted basis). There appears to be a strong size effect in tax exhaustion and the broadening of the sample achieved in this study (compared with Higson (1986)), by trading survival off against sample size, has introduced more small firms and has increased the proportion of tax exhausted firms by number. The sales weighted proportion of non taxpayers is accordingly much lower than the equal–weighted; 44% in 1980 against 55% by number.

Table 3a also shows results for the 73% of firms in the sample which were UK quoted. The incidence of tax exhaustion amongst UK quoted companies is rather lower in 1980 than for the whole population, on an equal weighted basis 50% of quoted firms were tax exhausted as against 55% in the whole population, but only 30% on a size weighted basis as against 44%. These figures are most directly comparable with those of the IFS whose research covered only quoted firms. Devereux calculated the percentages of companies tax–exhausted between 1982 and 1988 as 1982–36%, 1983–30%, 1984–22%, 1985–20%, 1986–12%, 1987–11%, 1988–12%. The Devereux series records a level of tax exhaustion which lies between the equal and value weighted series in Table 3a. Devereux aggregates accounts years ending in calendar years rather than tax years and this may further explain some the variance between the two series. In truth, the results of Devereux for tax–exhaustion are broadly consistent with the results in this paper.

However the sample includes three other significant groups which display a very different

incidence of tax exhaustion. Around 150 companies, 15% of the sample by number, were subsidiaries of foreign multinationals. This group experienced a much higher incidence of tax exhaustion than UK quoted throughout the period, despite being slightly larger on average in terms of sales. Tax exhaustion peaked in 1982 for this group on a size–weighted basis, and remained at a high level until the end of the observation period. These data are consistent with the popular assertion that foreign owned entities are able to reduce their exposure to UK taxation. By contrast, the UK unquoteds in the sample track quoteds but, like foreign subsidiaries, display a substantially higher proportion of firms with tax exhaustion despite, again, being no smaller on average than quoteds.

Notwithstanding their small number public utilities had the same sales revenues in aggregate as the unquoted group. All four of these companies were non–taxpaying between 1978 and 1984 and the very high incidence of non–taxpaying amongst this important group significantly raises the average for the UK economy.

No aggregate series exist on tax exhaustion. However the Corporation Tax Green Paper (cmnd 8456, Jan. 1982), contained the following statement:

> The available information on this [tax exhaustion] relates to industrial and commercial companies excluding North Sea oil and gas producers. 30% of these consistently pay mainstrean tax each year. They account for 40% of the gross total income before depreciation, and nearly 70% of the taxable income of the sector. A further 33% of such companies move in and out of tax liability from year to year: these earn around one–third of the sector's total gross income, and just over 30% of its taxable income. The remaining 37% of such companies, with about 25% of the sector's total gross income, never or very rarely pay mainstream tax.....Almost 40% of large companies are consistent mainstream payers, compared with only 29% of small ones...(p133)

It is not entirely clear what period was being described here, or, particularily with respect to size, how the population of companies relates to our sample. On the assumption the Green Paper is refering to the period around 1980, the figures are consistent with the results in Table 3a. The Green Paper suggests that non taxpaying is inversely related to company size. The significant difference between equal and value weighted proportions of

non taxpaying firms supports this conclusion, though as is noted later there may be a countervailing unrelieved ACT effect.

5.3 The Incidence of ACT exhaustion

Table 3b shows the proportion of firms in the sample with unrelieved ACT. On a size weighted basis around 80% of firms in the sample had unrelieved ACT in the years 1979–1981. The experience of quoted and unquoted firms was much closer in this respect than for tax exhaustion. In the mid–1980's, however, the incidence of unrelieved ACT declined more rapidly in the quoted group.

Table 3b does not report ACT figures for overseas subsidiaries or utilities. It is difficult to talk meaningfully about the ACT position of overseas subsidiaries which under the terms of the relevant double tax treaty are likely to remit dividends gross of ACT. It is also pointless to examine the ACT position of utilities since their high level of tax exhaustion left little scope for relieving ACT.

Edwards et al (1985) report a much lower level of unrelieved ACT for UK quoteds in the 1970's than does the present study: 1974–48%, 1975–41%, 1976–37%, 1977–37%, 1978–38%, 1979–43%, 1980–48%, 1981–53%. The Edwards data are indeed difficult to reconcile with the underlying data on tax exhaustion reported in the previous section, when it is recalled that the set of tax exhausted firms must be a subset of that with unrelieved ACT. A possible explanation is that the Edwards data are based on reported write–offs of ACT, but evidence in Chapter 4 suggested that reported write–offs may understate the true level of unrelieved ACT.

TABLE 2 ACCOUNTS DATA ON THE PERCENTAGE OF FIRMS NONTAXPAYING

This table shows the percentage of companies with zero UK corporation tax charge on the Exstat tape year by year, before and after netting double–tax relief. Percentages are also shown for key subgroups of the population: survivors/non–survivors, large/small, and (post–1977)domestic/overseas.

	Gross of DTR			Netting DTR						
Year	*All*	*Survivors*	*Non–Survivors*	*All*	*Survivors*	*Non–Survivors*	*Large*	*Small*	*Domestic*	*O'Seas*
	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
1972	9.4	7.7	12.0	10.3	8.8	12.8	9.2	9.4	...	...
1973	9.4	8.0	11.5	10.2	9.0	12.2	9.8	9.3	...	...
1974	20.4	18.0	24.2	22.5	20.1	26.4	16.0	22.0	...	...
1975	22.8	20.9	25.9	25.0	23.3	27.9	20.8	23.6	...	...
1976	28.8	28.0	30.4	30.8	30.3	31.9	23.5	30.8	...	...
1977	29.9	27.5	33.7	31.8	29.7	35.2	25.1	32.0	...	...
1978	30.8	28.1	34.8	32.5	29.7	36.6	25.6	33.3	30.8	25.0
1979	38.2	35.8	41.7	40.8	38.6	44.0	32.8	41.2	38.3	26.7
1980	47.4	46.3	48.8	49.8	49.1	50.9	42.8	50.1	47.3	47.6
1981	44.9	42.2	48.5	47.6	45.9	49.8	37.8	49.4	45.1	37.3
1982	39.1	36.9	41.7	41.4	40.2	42.9	33.2	43.0	40.0	32.5
1983	37.4	36.3	38.6	39.2	39.0	39.9	32.4	40.9	38.8	28.6
1984	32.2	31.6	32.8	34.0	34.5	33.5	27.7	35.8	33.8	23.4
1985	26.5	27.7	25.4	27.9	29.9	26.1	23.6	29.1	27.7	20.1
1986	21.1	20.3	21.8	22.0	21.7	22.3	18.3	23.8	21.2	20.5
1987	17.7	16.5	18.8	18.4	17.7	19.1	16.2	19.4	17.6	18.5
1988	15.8	13.5	17.6	16.4	14.6	17.8	13.1	18.8	15.7	15.9
1989	11.3	9.0	12.6	11.7	10.0	12.6	8.6	13.5	11.5	10.6

TABLE 3 MODEL ESTIMATES OF TAX AND ACT EXHAUSTION

Model estimates of the proportion of sample firms tax exhausted (panel A) and ACT exhausted (panel B) are shown on a size–weighted basis (s), and equal–weighted basis (e) in total and for component groups.

(A) MAINSTREAM EXHAUSTION

	All Firms (999)		Quoted (728)		Unquoted (115)		Overseas Subsidiaries (152)		Utilities (4)	
	s	e	s	e	s	e	s	e	s	e
1973	19	9	2	6	46	9	22	26	100	100
1974	28	21	10	18	60	32	32	31	100	100
1975	26	24	8	19	51	34	28	42	100	100
1976	32	31	17	28	59	36	33	41	79	75
1977	30	30	16	26	51	39	32	43	80	75
1978	32	33	11	28	71	41	33	46	100	100
1979	40	48	25	44	57	58	42	59	100	100
1980	44	55	30	50	62	63	50	70	100	100
1981	41	49	27	44	62	56	51	63	100	100
1982	39	42	20	37	62	44	62	59	100	100
1983	34	42	17	38	57	45	53	55	100	100
1984	30	37	13	33	60	40	50	49	100	100
1985	29	30	14	27	63	31	40	42	85	75
1986	18	20	6	17	53	21	34	38	32	50
1987	17	18	3	15	50	19	29	32	83	75
1988	10	16	3	12	6	22	24	28	71	50

(B) ACT EXHAUSTION

	All Firms		Quoted		Unquoted	
	s	e	s	e	s	e
1975	50	47	44	46	61	52
1976	58	51	40	52	85	46
1977	63	64	47	63	87	70
1978	71	73	54	72	93	81
1979	81	78	61	78	93	82
1980	79	80	75	80	91	82
1981	80	79	73	79	93	80
1982	75	77	74	77	91	81
1983	66	73	68	72	86	78
1984	64	69	58	67	85	77
1985	54	59	56	58	81	68
1986	42	50	45	48	77	61
1987	44	45	37	43	72	56
1988	38	39	35	38	69	46

6 RESULTS: ESTIMATED TAX RESUMPTION LAGS AND EFFECTIVE TAX RATES

6.1 Tax resumption lags

Whilst the previous section detailed the proportions of firms non taxpaying, and with surplus ACT, it did not investigate the depth of their condition. Table 4 calculates the lags in tax resumption which these tax exhausted firms faced, focussing on the quoted group. Hence, for example, Table 3a showed that in 1981 44% of quoted firms were non–taxpaying. Table 4a shows that, of these firms, 15% would pay tax in the following year, 13% in 2 or 3 years, 10% in 4 or 5 years, and 5% sometime after that. Table 4a displays rather graphically the flow and ebb of the tax exhaustion phenomenon over the period. By 1986 relatively few firms were non taxpaying for more than a year, though there remained a rump of around 5% of deeply tax exhausted firms.

Since the corporation tax charge bounds the offset of ACT, the incidence of ACT exhaustion is much deeper than for mainstream. This is significant as, particularly since 1984, ACT has been the dominant element in the effective tax rate for UK firms. For instance, Table 4b shows that in 1981 49% of firms would not relieve marginal ACT for more than five years, and 31% for at least 8 years. As tax exhaustion abated in the mid–eighties, unrelieved ACT abated in its wake so that by 1988 62% of firms were able to relieve ACT credits. Notably, however, there was still a rump of 19% of firms in 1988 which were deeply ACT exhausted.

6.2 Sensitivity Analysis

Estimates of tax resumption are clearly sensitive to assumptions on the evolution of tax generating variables beyond 1988. Table 5 explores some of these sensitivities by tracking the proportions of firms tax and ACT exhausted from 1984 to a 1996 horizon under different assumptions. The base case assumption in Tables 3 and 4, reproduced as column

a in Table 5, forecast beyond 1988 on the assumption of 1) a common economy–wide growth rate (no idiosyncratic growth) and 2) recovery for negative and low growth companies. Table 5 columns b and c relax these assumptions in turn.

Column a assumes that firm–specific historic trends in earnings growth were maintained after 1988. The assumption that firms maintain their own idiosyncratic growth rate makes little difference to the overall proportions of firms with tax exhaustion and unrelieved ACT. However, the assumption on recovery is more significant – column c shows that without it around 5% more firms would be tax exhausted in each year. The decline in tax exhaustion post 1984 could be due to the 1984 tax reform, when stock relief and 100% first–year write–offs for plant and machinery were abolished, and when the corporate tax rate was reduced in stages from 52% to 35%, but could also be due to the significant recovery in corporate profits over this period. To assess the relative importance of these two factors the tax model was run on the scenario of actual earnings, but with the pre–Lawson tax regime continuing. These figures assume taxable earnings are inelastic with respect to tax regime; the company does not respond to changes in tax regime. Despite this element of artificiality, they contain interesting insights. Table 5, columns d show the results of this exercise. Even without the Lawson reforms the underlying profit growth was sufficiently vigorous to have halved the number of non–taxpaying firms by 1988. Thereafter, with the more modest profits growth projected by the LBS macroeconomic model after 1988, the estimates in Table 5 suggest that without the Lawson tax reforms the UK would have fairly rapidly returned to a position where around 30% of companies had a zero corporation tax charge. However, the projections suggest that without Lawson a large and stable group would have continued to have unrelieved ACT credits.

6.3 Effective tax rates

Effective corporate tax rates were calculated for each company over the period 1973/1988, based on the actual tax resumption experience of firms and a non–stochastic forecast of tax resumption after 1988. Tax resumption lags of greater than 15 years were treated as infinite. To display the inter– and intra–industry variation in the effective tax rate over the whole period Table 6 shows the quartiles of the effective tax rate distribution for industry groups for three years 1976, 1980, and 1986, one early in the observation period, one at the height of the tax exhaustion phenomenon, and one post the 1984 tax reform. The striking implication of Table 6 is the variation in tax rates both within and between industries. Amongst the most deeply tax exhausted industries in 1980, such as motors and metals, the median effective tax rate was only half the statutory rate in 1980.

Though these rates describe the outturn of UK quoted companies' tax experience, they may not capture expectations. Apart from anything else, casual empiricism suggests that companies did not anticipate the 1984 tax reforms. To assess the divergence between ex post and ex ante Figure 1 displays the quartiles of the effective tax rates for the quoted companies each year from 1976 to 1988, and against them, quartiles of the rates generated by a stochastic simulation. In this simulation earnings grow at the economy rate forecast by the LBS macroeconomic model, and tax rates and rules are expected to continue at the levels ruling each year except between 1984 and 1986 when firms were given advance notice of tax rate changes. Whilst actual and expected tax rates at the upper quartile coincide after 1979 – future tax rates are irrelevant to the current tax rates of fully taxpaying firms – they diverge markedly at the median and lower quartiles. The median effective tax rate for quoted firms in 1983 is inflated by 10% by the hindsight implicit in the perfect foresight forecast. Hence Figure 1 quantifies the perhaps rather obvious perception that without the ability to anticipate the Lawson tax reforms and the economic growth of the 1980's many UK firms would have had an expectation of the

effective tax rate which was significantly more pessimistic than the outtum.

As important as the expected rate of tax may be the variance of that rate. Stochastic simulation permits the estimation of a point estimate of the uncertainty associated with each expected tax rate in terms of the standard deviation of the component rates along each path. One would expect the intermediate group to experience most uncertainty about their tax rates. Figure 2 plots each company's expected effective tax rate against the standard deviation of that rate across paths, for 1980 and for 1986. Both the deeply tax–exhausted and fully–taxpaying firms are relatively certain about their tax rates, but the expected tax rates of intermediate group, the temporarily non–taxpaying firms, have high standard deviation in 1980. By contrast, in 1986 the standard deviation of expectations had declined significantly across the whole range, due in the main to the narrower limit of a 35% tax rate.

TABLE 4 **TAX AND ACT RESUMPTION LAGS**

This table categorises quoted firms according to the length of their expected tax and ACT resumption lag. The ACT estimates start in 1976 after the introduction of the imputation system in 1975. These data can be related to Table 3 by noting that the proportion of firms with a zero tax resumption lag and which are therefore taxpaying is the complement of the equally–weighted proportion for quoteds in Table 3.

	(A) RESUME MAINSTREAM TAX					(B) RESUME ACT				
	Lag to resumption in years					Lag to resumption in years				
	0	1	2–3	4–5	>5	0	1	2–5	6–7	>7
1973	94	2	2	0	2					
1974	82	8	4	1	5					
1975	81	7	6	0	6					
1976	72	13	5	2	7	48	8	4	2	36
1977	74	8	5	5	8	38	6	3	3	49
1978	72	6	8	5	9	28	2	8	8	54
1979	56	9	17	7	10	22	4	15	8	50
1980	50	17	16	8	9	20	4	23	14	38
1981	56	15	13	10	5	21	5	25	18	31
1982	63	10	14	8	5	23	6	28	17	26
1983	62	12	17	5	4	28	7	28	14	23
1984	67	12	14	4	3	33	11	23	12	21
1985	73	14	8	2	4	42	11	18	9	20
1986	83	6	5	1	4	52	8	13	6	20
1987	85	6	3	1	5	57	8	13	3	19
1988	88	4	2	1	5	62	8	9	2	19

TABLE 5 **SENSITIVITY ANALYSIS**

Proportions of mainstream and ACT exhausted quoted firms are reestimated under alternative assumptions to those of the base–case (column a). These are, respectively, that post–1988 firm earnings grew at their idiosyncratic rate estimated over the previous five years rather than at the economy forecast rate (column b), that there was no recovery for unprofitable firms post 1988 (c), and that there was no corporation tax reform in 1984 (d).

	(A) MAINSTREAM EXHAUSTION				(B) ACT EXHAUSTION			
	a	*b*	*c*	*d*	*a*	*b*	*c*	*d*
1984	33	–	–	33	67	–	–	68
1985	27	–	–	27	58	–	–	59
1986	17	–	–	17	48	–	–	52
1987	15	–	–	15	43	–	–	49
1988	12	–	–	15	38	–	–	50
1989	12	12	13	24	34	32	34	53
1990	13	13	15	28	31	29	32	54
1991	14	14	17	28	29	27	31	51
1992	15	15	18	29	28	27	30	50
1993	14	16	19	29	29	29	32	48
1994	15	18	20	29	28	28	32	47
1995	16	19	21	30	27	28	31	46
1996	16	20	22	30	27	28	31	46

TABLE 6 EFFECTIVE TAX RATES

Estimated effective tax rates are shown for Stock Exchange industry groups in three representative years, 1976, 1980, 1986. The quartiles of the distribution are shown, with a dash where this is the full statutory rate. Statutory rates were 52%, in the first two periods and 35% subsequently.

	1976			1980			1986		
S.E. Industry Groups	Q1	Med	Q3	Q1	Med	Q3	Q1	Med	Q3
	%	%	%	%	%	%	%	%	%
1 Building Materials	24.0	–	–	31.1	39.4	–	31.4	–	–
2 Contracting & Construction	20.9	29.3	–	22.8	30.0	39.0	28.6	–	–
3 Electricals	22.6	44.8	–	27.5	30.6	36.8	27.1	–	–
4 Electronics	24.6	47.1	–	28.3	44.8	–	–	–	–
5 Eng. Aerospace	22.2	31.5	49.6	25.6	36.8	50.1	23.4	–	–
6 Eng. General	20.6	–	–	21.4	31.7	45.2	19.4	34.6	–
7 Metals, Metal Forming	21.8	44.8	–	19.9	24.4	34.4	22.6	30.3	–
8 Motors	17.2	21.0	39.2	18.3	27.7	34.0	20.1	29.3	–
9 Other Industrial Material	23.6	36.2	–	27.7	32.0	36.4	27.4	31.8	–
10 Brewers & Distillers	27.4	–	–	29.9	43.4	–	–	–	–
11 Food Manufacturing	20.5	35.5	–	24.0	30.7	37.2	14.7	34.4	–
12 Food Retailing	27.3	–	–	26.1	36.6	48.7	20.4	33.9	–
13 Health & Household Produc	27.6	29.3	–	24.2	39.0	41.6	12.4	–	–
14 Leisure	26.6	–	–	24.0	34.5	–	12.4	–	–
15 Packaging & Papers	20.7	–	–	17.2	27.8	34.8	13.7	27.6	–
16 Publishing & Printing	33.3	–	–	18.9	29.5	29.2	14.7	–	–
17 Stores	24.9	–	–	29.9	39.0	–	32.6	–	–
18 Textiles	17.7	24.4	47.2	21.3	28.3	35.1	18.5	31.8	–
19 Agencies	20.9	38.0	–	26.4	39.2	–	17.6	–	–
20 Chemicals	28.8	–	–	22.3	30.7	40.9	25.7	31.8	–
21 Conglomerates	18.1	22.6	–	23.3	27.2	36.5	16.2	28.3	–
22 Transport	7.6	18.4	–	14.5	23.2	29.7	12.3	19.6	31.0
25 Miscellaneous	24.1	–	–	24.2	32.3	43.6	22.9	33.6	–

Note: There was no sample in 23 Telephone Networks, and 24 Water

FIGURE 1

QUARTILES OF QUOTED COMPANY EFFECTIVE TAX RATES

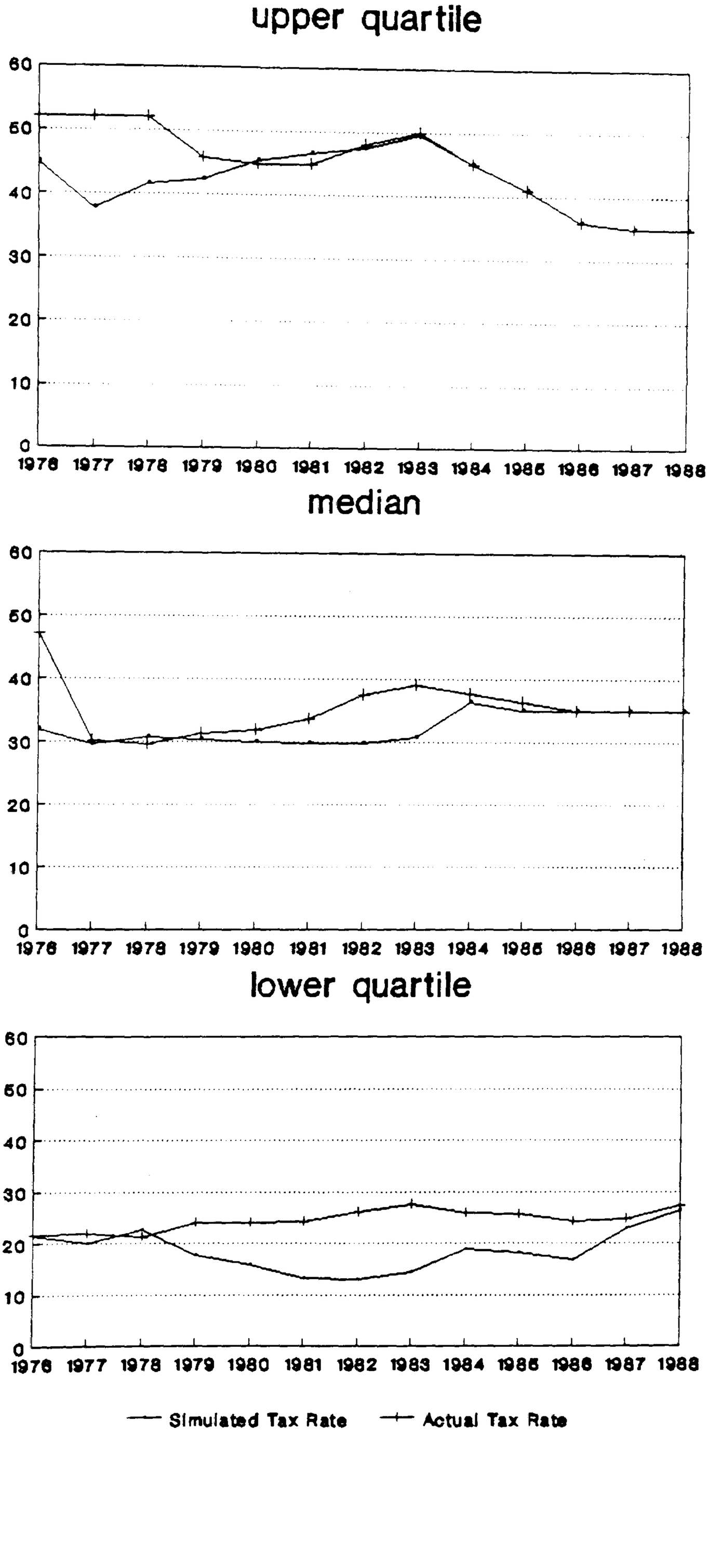
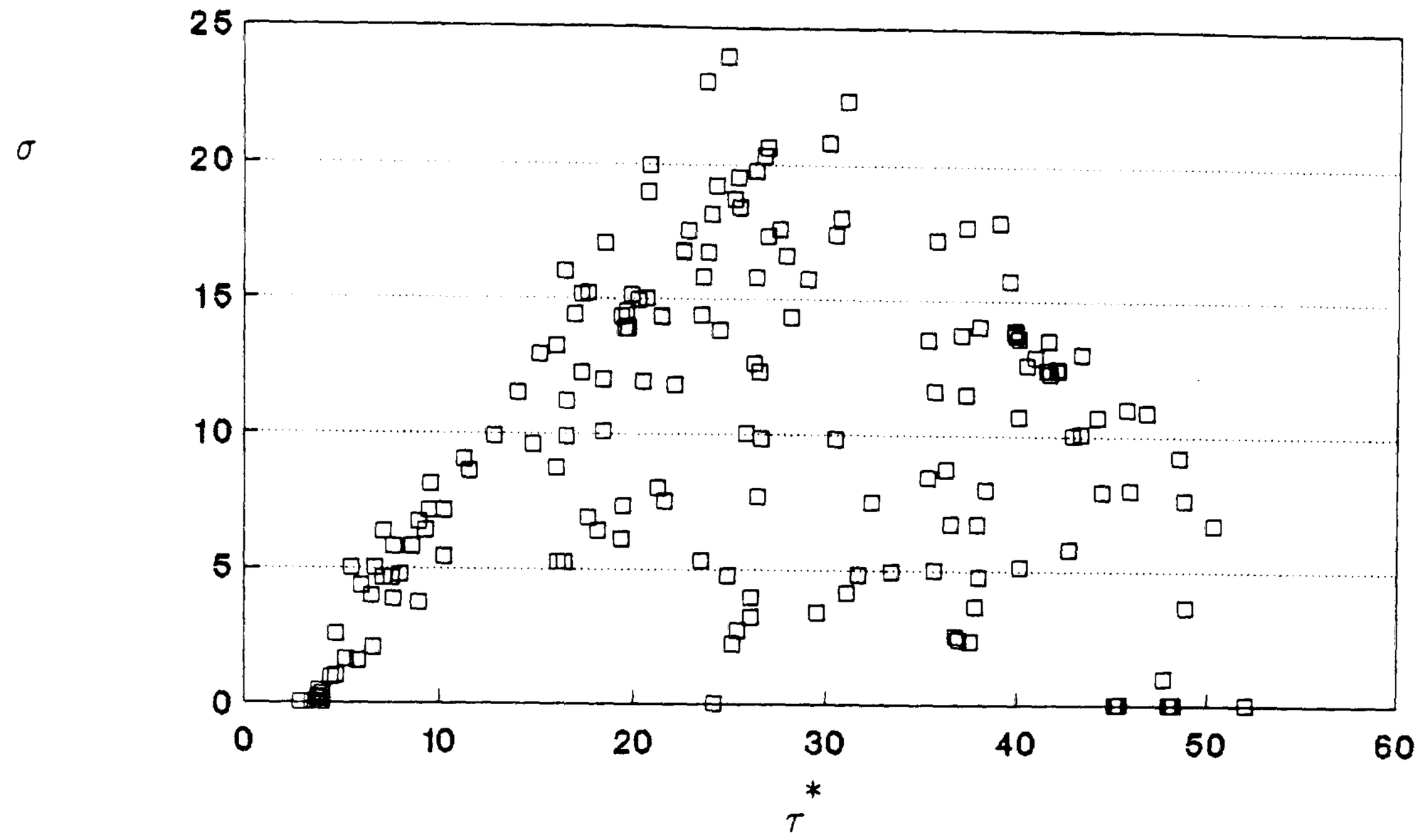
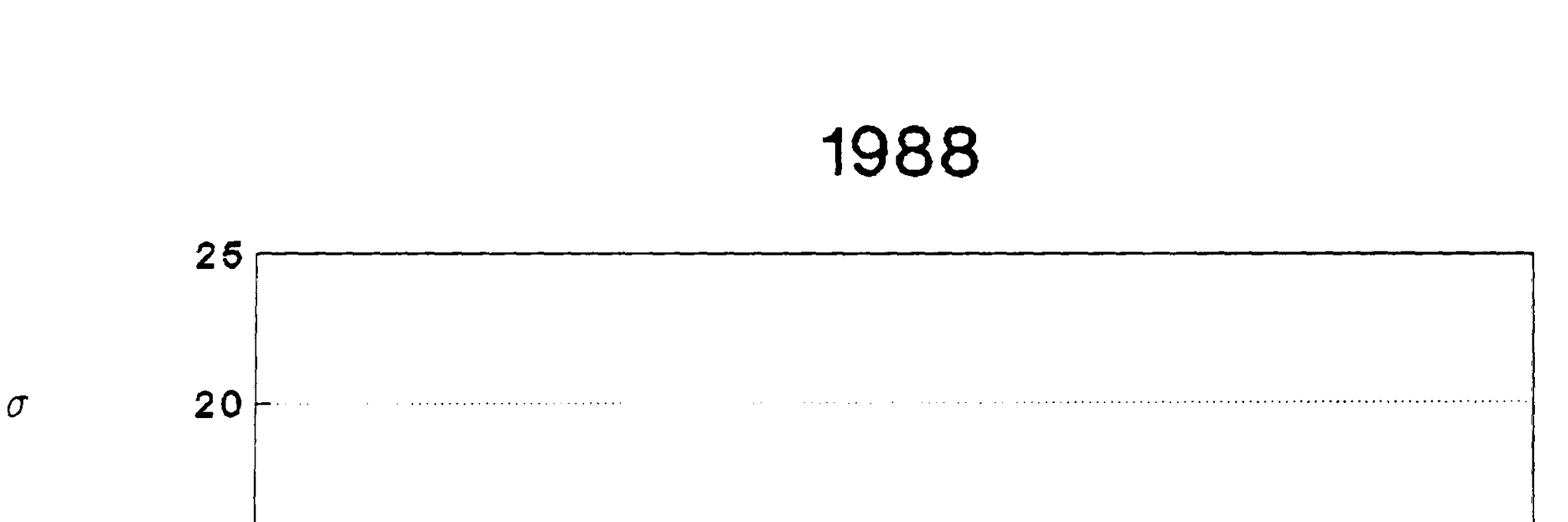


FIGURE 2

STOCHASTIC TAX RATES:
EXPECTATION (τ^*) VERSUS STANDARD DEVIATION (σ)





7 CONCLUSIONS

Using a detailed model of the UK corporation tax and tax data published by companies, this paper shows endemic and widespread tax exhaustion in a section of the UK company population, implying a significant diversity in the tax incentives faced by companies, and suggesting real frictions in corporate tax arbitrage markets. Though mainstream tax exhaustion abated after the 1984 Lawson tax reform, there remained a significant number of companies with unrelieved ACT. Since 1984 ACT became the dominant element in the effective tax rate of UK corporations and this meant that there remained a group of companies with low marginal tax rates.

Most published work in this area has hitherto used a 'survivor' sample of quoted companies. The present study suggests that results from these panels understate the depth of tax exhaustion in key sectors of the economy. Other significant sectors: unquoteds, utilities, and the subsidiaries of foreign multinationals, had a higher proportion of non–taxpayers during the period under review, as did quoted firms which did not meet the survival criteria. The latter finding suggests a size effect, but it appears that size is largely proxying other tax generating variables, notably profitability.

This study also simulated expected corporate tax rates in the face of uncertainty about earnings and tax rates, yielding measures of the variance as well as the mean of point estimates of company effective tax rates. The data suggest that the intermediate group of temporary non–taxpaying firms form expectations about the tax effects of their actions that have high variance, and that the expectations of UK companies in the period pre–1984 were probably more pessimistic than would be implied by a concentration on outturns.

CHAPTER 6

UK CORPORATE BORROWING

This paper describes the borrowing behaviour of UK corporations between 1972 and 1988, and tests an empirical model of corporate leverage. In this model the firm's capital structure is a function of the effective tax rate it faces on interest and dividend payments, and of size, profitability, uniqueness, earnings volatility and asset structure.

1 INTRODUCTION

If firms adjust their borrowing in response to tax incentives the UK of the 1970's and 1980's should be a good place to observe it. The UK has an imputation system of corporation tax in which firms can deduct interest payments at the corporate tax rate and dividends at the basic rate of personal tax. Prior to 1984 the corporate rate had been 52% while the basic personal rate had varied between 30% to 35%, giving a tax rate advantage to borrowing for a fully–taxed, full–payout firm of around 20%. Immediately after the Lawson tax reform of 1984 this 'wedge' narrowed to 5%. There was a spate of equity issues in the UK after 1984 which some commentators attributed to the shift in incentives. Moreover, at any statutory tax rate there was considerable cross–sectional diversity in the effective tax rates faced by UK firms. Low profitability and immediate write–offs for plant and for inventories generated widespread tax losses amongst UK firms in the late seventies and early eighties. Opportunities to arbitrage these tax losses, for instance by writing leasing contracts, were limited in supply. As a result some firms became 'tax exhausted' for lengthy periods and had a much reduced expected value for corporation tax deductions. A larger group had surplus dividend tax credits so were facing a classical tax system at the margin.

Theory predicts that, other things equal, firms with lower effective tax rates will borrow less, but to date a large empirical literature has produced inconclusive or perverse evidence on the relationship between taxes and corporate borrowing. This empirical failure to establish a tax effect may reflect the quality of the proxies researchers have used for interest tax shields. One contribution of the present paper is to attempt a much richer modelling of the expected value of tax deductions to individual firms than has previously been attempted in this literature. A detailed model of the corporation tax system is used to estimate a firm's tax history and thus its stock of tax losses and surplus dividend credits at each date, and to forecast the future evolution of its tax liabilities. The implied effective tax rates are used to test for tax effects on capital structure, controlling for other factors which may influence the borrowing decision. The second contribution of the paper is to provide the first full empirical study of UK corporate borrowing behaviour over the last two decades. Evidence is presented on the borrowing behaviour of the UK industrial and commercial sector. The paper then tests a cross–sectional model of the debt ratio using data on a panel of 444 quoted firms over the period 1972 to 1988.

The main findings are as follows:

– The distinction between short and long term borrowing is empirically significant and there are distinct profiles for these two elements of corporate debt. Firms borrow long term when they are larger, less profitable in terms of return on assets, and when they have securable (=fixed) assets. Size is not a determinant of short term borrowing. Firms borrow short term when they have low return on assets and low margins, and when they have a low effective tax rate.

– Overall corporate debt levels mainly reflect size and (lack of) profitability, ther latter consistent with Myers'(1977, 1984) 'pecking–order'.

– The profitabilty/borrowing nexus is indeed so powerful as to reverse two predictions of

conventional theory. Firms with higher business risk borrow more. Moreover the firm's effective tax rate is a good predictor of debt ratios, but with perverse sign.
Non–taxpaying firms borrow more. The firm's effective tax rate, and to a lesser extent its business risk, are inversely correlated with profitability and apparently proxy financial condition.

– In this study R&D expenditure is a positive predictor of borrowing, counter to the predictions of 'uniqueness' theory. A picture of the relationship between asset structure emerges in which firms are able to borrow long term when they have fixed asset backing, and are less likely to borrow against market equity but are able to leverage growth opportunities associated with R&D expenditure.
– Debt ratios measured on market equity add nothing to those based on book empirically.

The paper is organised as follows. Section 2 describes the borrowing patterns of UK firms over the 1970's and 1980's and introduces the dependent variables for the study. Section 3 explains the tax treatment of interest and dividends in the UK institutional setting and specifies the tax variables used in the empirical model. Section 4 reviews some alternative hypotheses on capital structure and introduces the remaining elements of the empirical model. Section 5 presents the empirical results, and Section 6 draws some conclusions.

2 BORROWING PATTERNS OF UK FIRMS

2.1 Construction of the Sample

Data were taken from the UK Exstat tape on firms which met the following criteria.

– Though there is no survivorship requirement for inclusion on the Exstat tape which records annual accounts information for all UK quoted firms and other members of the Times 1000[1], estimation of the tax parameters in this study needs a run of several years to allow estimates of non–disclosed tax variables such as stocks of tax losses and tax resumption dates to be generated. Data were included for firms which, as a minimum, were on tape between 1976 and 1986. This period effectively encompasses the period of deepest tax exhaustion in the UK.[2] An exercise was undertaken to identify ownership–type and to match share price data from the London Share Price Database(LSPD) with the sample.

– Because of the difficulty of modelling tax positions for firms with significant overseas income firms which averaged over 40% of their income from overseas were excluded.

– Financial and property companies, for which data is not available on Exstat, and oil companies because of their idiosyncratic tax treatment, were all excluded. The major utilities such as gas, electricity and telecoms were excluded since they dramatically skew the trend; they carried very highly geared capital structures prior to privatisation in the 80's.

– For testing the empirical models the sample was restricted to a panel of quoted firms with data from 1972 to 1988[3] and cross–sectional models are tested using three year

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[1]Dead firms are retained on the Exstat file.

[2]Firms excluded because of the survivorship requirment comprised about 20% of the capital employed of the population of UK industrial and commercial firms. These firms are likely to be firms which died, perhaps bacause of takeover, before 1986, or did not qualify, perhaps because they were new companies, until later than 1976. A check suggested that the debt ratios of these companies were not significantly different to those of survivors.

[3]Which includes year–ends up to April 1989. The most popular accounting year–end for UK firms is 31st December, so the closest fit to calendar years is got by collecting years mid–April to mid–April.

averages of dependent and independent variables for the sub–periods 1975–1977, 1980–1982, 1985–1987. The first is a period before tax exhaustion reached its peak in the UK, the second period is at the peak of tax exhaustion and the third period is after the 1984 Lawson tax reforms. The balanced panel of quoted firms was used so that debt ratios could be measured both at book and market values, and the behaviour of a fixed cohort could be tracked across periods.

2.2 Specification of the debt ratio

The dependent variable in this study is the debt ratio, measured as the ratio of year–end borrowing to year–end stockholders' equity. Debt ratios are measured for total debt, short term debt, and long term debt where 'long–term' has a maturity beyond one year. Additionally equity is measured at both book and market values, giving six equations for model estimation. Debt and equity are categorised on the basis of their tax treatment; book equity includes ordinary shareholders funds, preference shares, minority interests, and deferred tax provisions. Debt includes convertible bonds, but excludes finance lease liabilities and other off–balance sheet instruments.

When estimating models of the debt ratio we control for a number of non–tax factors and it could be argued that a classification based on tax treatment might be inappropriate for some of the other hypotheses proxied in the empirical equation; one example is risk, where investors might view preference stock as quasi–debt from a risk perspective. However, for the following reasons the debt/equity taxonomy used here appears reasonably robust. Over the period of this study preference shares were of minor significance in the UK though there was some growth in preference stock issues, often convertible, in the late 1980's. According to Rutterford (1986) preference shares had comprised 21% of the book value capital (debt plus equity) of UK firms in 1915 and up to the second world war preference shares easily dominated debt in UK balance sheets. But

after a classical tax system was introduced in the UK in 1965 a significant number of companies refinanced with debt (Kirkman and Usher (1971)) so that by 1979 preference shares comprised under 0.2% of the capital of UK firms. Though many larger UK firms have convertible debt this is not separately disclosed on the Exstat tape; hence it was not possible to test a seperate model for convertibles. While Titman and Wessels (1988) did separately model convertibles it was the least successful of their equations and was not apparently statistically significant. Leasing grew rapidly in the late 1970's and early 1980's and was the main tax arbitrage vehicle for tax exhausted firms though UK firms were not required to capitalise lease liabilities in the balance–sheet until 1981 under SSAP21[4]. For consistency lease liabilities have been excluded from debt ratios throughout. This is not troublesome in the present context where the empirical focus is the effect of tax exhaustion on borrowing; tax exhausted companies are predicted to lease their assets and to avoid borrowing, and empirically we are regressing borrowing on the company's post–lease–arbitrage tax positions. Other forms of off–balance sheet borrowing, for instance borrowing through unconsolidated subsidiaries, were controversial in the 1980's but were probably not significant in aggregate over the period of study.

Debt ratios are measured both at book, that is using balance–sheet values of debt and equity, and at market using book debt and market equity. The reason for using book debt in the latter ratio is pragmatic: there is relatively little quoted debt in the UK and previous researchers have found little statistical effect of using market rather than book debt (see, for example, Marsh (1982)). Market capitalisations were estimated using share price data from the London Share Price Database (LSPD). To reduce bias induced by market movements prices were taken on 31st December rather than at firms' disparate financial year ends.

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[4]Even after the introduction of Statement of Standard Accounting Practice (SSAP) 21 capitalisation was only required for leases which passed the '90% test' whereby the present value of the contractual lease liabilities was at least 90% of the fair–value of the leased asset. This test proved fairly easy to circumvent.

2.3 Borrowing patterns of UK firms

999 firms met the sample inclusion criteria. These firms account for over 80% of UK industrial and commercial trading profits. Quoted firms make up around 73% of the sample by capital employed, other UK unquoted firms 20% and UK subsidiaries of overseas companies 7%. Table 1 describes the debt ratios for sample companies from 1972 to 1988. The book debt ratio of UK industrial and commercial firms fell during the late 1970's and most of the 1980's. The long–term debt ratio fell from 30% to just over 20% during this period. There was a rise in holdings of liquid assets which grew significantly after the 1979–1981 recession. Table 1 also shows debt ratios for sub–groups. The most striking is overseas subsidiaries whose long–term debt ratio fell from well over 30% in the early 1970's to 12% by 1988. In that year there is some evidence that long– and short–term debt was rising, and indeed in 1989 and 1990 UK quoteds increased their borrowings substantially.

Figure 1 plots the quartiles of the long and short term debt ratios on both book and market of 444 quoted firms for which we have data from 1972 to 1988. The stock market was rising through most of this period, so measured on the market value of equity the fall in debt ratios was even more pronounced. Measured on value the debt ratios pick up all of the movement in the market during this period, falling steadily from the very high levels recorded around 1974 as the market recovered in the late 1970's and early 1980's. Taggart (1985) surveys a number of, largely US–based, studies of the time series behaviour of debt–ratios. There is little evidence in the UK of the drift to higher debt ratios reported by Taggart for the post World War II US.[5]

Table 2 decomposes the sample into size deciles on the basis of market capitalisation in

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[5]He reports that over a long period pre–1960 US debt ratios were constant. In the 1960's and 1980's US debt ratios again rose (Miller(1963), Corcoran(1977), Zwick(1977), Sametz(1964), Schwartz and Aaronson(1967), Ciccolo and Baum(1985)).

the sub–periods 1975–1977, 1980–1982 and 1985–1987. The median long term and short term debt ratio is shown in each period and each size class. Though the size/debt relationship is by no means monotonic either in the case of long or short term debt, the debt ratio does appear to be related to size over at least part of the distribution, and the influence of size is apparently countervailing for short and long term debt. The two largest deciles borrowed two or three times as much long term as other firms in all periods. For short term borrowing the picture is more complex. In the middle period, 1980–82, median debt ratios increased for smaller firms across almost all size classes. In the earlier period only the smallest decile stands out as having twice the short–term borrowing of the 6th to 9th deciles which in turn are several percentage points more heavily levered than the larger half of the sample. No such generalisations can be made about the period 1985–1987 where no clear relationship exists between size and short–term borrowing.

Table 3 shows median debt ratios by FT Actuaries 25–sector classification in each of the three periods, and the rankings. Some sectors emerge as consistently high borrowers both long and short term: motors, conglomerates, health and household; while others are consistently low on both scores: brewers and distillers, general engineering.

TABLE 1

DEBT RATIOS OF UK INDUSTRIAL AND COMMERCIAL FIRMS

Size–weighted long–term debt, short–term debt, liquid assets and net debt on book equity for 999 UK industrial and commercial companies for which survived on the Exstat tape over 1976–1986. Ratios are also shown for three sub–groups: quoted firms, UK subsidiaries of overseas firms, other unquoteds.

All Companies

%

	Long–term Debt/Equity	Short–term Debt/Equity	Liquid Assets/Equity	Net Debt/Equity
1972	30.2	13.0	12.8	30.4
1973	29.1	14.5	14.3	29.3
1974	29.3	18.3	13.3	34.3
1975	31.5	16.4	14.9	32.9
1976	31.0	15.8	16.7	30.1
1977	28.4	15.1	16.1	27.4
1978	28.4	14.3	15.9	26.7
1979	25.4	15.1	13.7	26.9
1980	22.8	15.0	13.4	24.3
1981	23.2	15.3	14.6	23.8
1982	23.9	14.9	14.8	24.0
1983	22.1	12.4	16.9	17.6
1984	22.3	13.5	16.5	19.3
1985	19.7	12.5	17.7	14.4
1986	21.2	14.4	21.7	13.9
1987	20.3	12.0	20.2	12.1
1988	23.0	13.1	19.4	16.8

Quoted Companies

%

	Long–term Debt/Equity	Short–term Debt/Equity	Liquid Assets/Equity	Net Debt/Equity
1972	30.7	13.6	11.8	32.5
1973	29.5	15.2	12.8	32.0
1974	30.7	18.2	11.7	37.2
1975	32.6	16.5	12.5	36.6
1976	32.1	15.7	14.7	33.1
1977	29.8	14.9	15.1	29.6
1978	30.1	13.8	14.8	29.1
1979	26.5	14.8	13.2	28.1
1980	24.0	14.6	13.6	25.0
1981	23.5	15.2	14.5	24.2
1982	24.9	15.4	14.4	25.9
1983	23.5	12.8	15.4	20.9
1984	24.5	13.2	16.0	21.7
1985	21.9	12.9	17.8	17.0
1986	25.0	12.9	20.5	17.3
1987	23.5	12.2	20.2	15.4
1988	26.9	13.1	19.7	20.3

Unquoted Companies

%

	Long–term Debt/Equity	Short–term Debt/Equity	Liquid Assets/Equity	Net Debt/Equity
1972	27.0	9.9	17.2	19.7
1973	26.7	8.3	20.3	14.6
1974	24.3	13.0	19.6	17.6
1975	27.8	12.5	24.4	15.9
1976	28.7	12.7	25.7	15.7
1977	26.4	12.0	21.5	16.9
1978	26.2	12.0	20.9	17.3
1979	25.1	13.2	16.6	21.6
1980	21.7	13.7	12.9	22.6
1981	24.9	13.7	15.6	23.0
1982	23.8	11.8	16.5	19.1
1983	20.2	10.1	20.2	10.1
1984	18.4	12.5	18.1	12.8
1985	15.2	10.1	17.4	7.9
1986	12.3	17.7	24.5	5.5
1987	11.5	8.8	17.7	2.5
1988	11.6	8.9	17.0	3.4

Overseas Company Subsidiaries

%

	Long–term Debt/Equity	Short–term Debt/Equity	Liquid Assets/Equity	Net Debt/Equity
1972	37.1	18.9	8.9	47.1
1973	32.8	28.1	10.4	50.4
1974	31.0	38.4	8.1	61.3
1975	32.1	28.2	9.5	50.8
1976	28.2	26.1	9.7	44.6
1977	22.2	24.2	10.4	36.1
1978	19.8	23.6	12.4	30.9
1979	18.2	22.8	10.1	30.9
1980	16.1	20.7	13.4	23.3
1981	16.1	19.6	13.2	22.5
1982	16.4	19.3	13.3	22.4
1983	16.5	17.0	19.8	13.7
1984	14.9	20.1	15.5	19.5
1985	13.6	15.7	18.0	11.3
1986	12.9	18.8	24.1	7.6
1987	13.2	19.5	27.1	5.6
1988	12.3	26.6	22.7	16.2

TABLE 2 MEDIAN DEBT RATIOS BY SIZE CLASS

Median debt ratios are shown within each size–decile, where each decile contains an equal number of firms.

	Average Market Value in each decile (£ million)			*Long–term Debt/ Book Equity % (medians)*			*Short–term Debt/ Book Equity % (medians)*		
Decile	'75–'77	'80–'82	'85–'87	'75–'77	'80–'82	'85–'87	'75–'77	'80–'82	'85–'87
1	247.9	641.6	1774.0	27.9	17.8	26.2	9.6	10.0	11.2
2	48.4	108.0	386.5	19.6	15.6	19.0	9.1	9.7	7.4
3	15.7	39.4	131.2	11.0	11.3	8.9	10.3	11.4	9.6
4	8.7	19.0	66.3	5.0	8.7	10.8	6.4	11.7	12.0
5	5.4	11.6	41.2	8.1	9.9	9.5	10.7	13.3	13.9
6	3.9	8.3	26.4	9.9	5.7	5.9	13.8	13.8	8.3
7	2.9	5.5	17.7	9.3	10.6	9.3	14.5	17.0	11.3
8	1.9	3.3	10.9	2.3	11.1	6.1	13.8	26.6	23.4
9	1.2	2.0	6.8	7.9	4.5	3.4	14.6	22.6	18.7
10	0.5	0.9	2.8	5.1	3.0	3.4	25.8	33.1	17.7

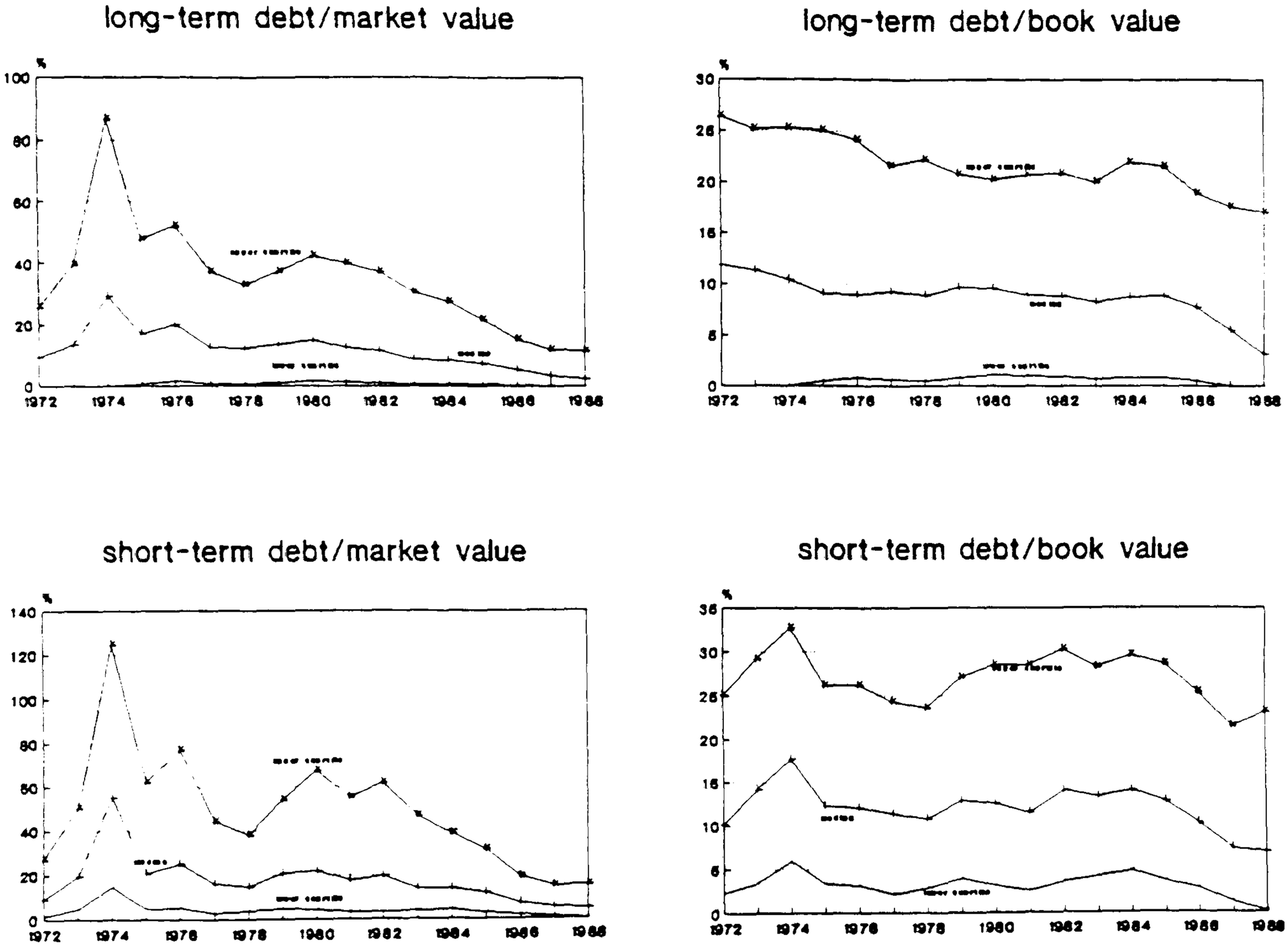
TABLE 3 DEBT RATIOS BY SECTOR

Median debt ratios are shown for each sub–period by FT Actuaries sector (The component industries of these sectors are shown in the Appendix). Rankings are in italics, where 1 is the highest and 25 the lowest debt ratio.

	Number of Companies	*Long–term Debt/ Book Equity % (medians)*						*Short–term Debt/ Book Equity % (medians)*					
INDUSTRY	'80–'82	'75–'77		'80–'82		'85–'87		'75–'77		'80–'82		'85–'87	
Building Materials	27	9.3	*15*	14.1	*9*	13.1	*7*	13.9	*7*	12.0	*13*	9.3	*16*
Contracting & Construction	29	2.7	*23*	2.8	*21*	6.1	*19*	9.8	*15*	15.7	*7*	22.6	*3*
Electricals	12	0.8	*24*	0.9	*24*	7.2	*18*	10.0	*14*	10.2	*18*	6.6	*22*
Electronics	12	15.2	*8*	10.2	*13*	3.8	*21*	9.4	*16*	10.0	*19*	11.6	*12*
Engineering: Aerospace	6	14.9	*9*	12.2	*11*	9.3	*13*	18.7	*5*	12.4	*12*	10.9	*14*
Engineering: General	41	8.2	*17*	7.6	*16*	9.1	*14*	9.1	*18*	13.4	*8*	9.2	*17*
Metals, Metal Forming	21	6.9	*19*	12.1	*12*	8.3	*15*	21.3	*4*	29.0	*2*	20.8	*4*
Motors	31	20.6	*4*	15.9	*7*	14.2	*6*	27.1	*1*	41.7	*1*	26.2	*1*
Other Industrial Material	13	16.3	*7*	9.4	*15*	7.6	*17*	11.2	*12*	9.1	*21*	20.7	*5*
Brewers & Distillers	23	10.0	*14*	7.3	*17*	4.3	*20*	5.3	*20*	2.5	*24*	4.7	*23*
Food Manufacturing	21	16.8	*6*	14.5	*8*	10.7	*12*	14.9	*6*	12.7	*10*	11.5	*13*
Food Retailing	11	3.7	*21*	1.7	*23*	1.4	*23*	8.3	*19*	11.7	*15*	15.2	*7*
Health & Household Products	5	26.9	*1*	16.3	*6*	17.7	*5*	13.8	*8*	17.1	*4*	23.2	*2*
Leisure	16	13.1	*11*	13.1	*10*	11.3	*9*	4.8	*22*	12.4	*11*	8.5	*20*
Packaging & Paper	13	14.2	*10*	17.2	*4*	10.7	*11*	10.2	*13*	17.0	*5*	14.1	*10*
Publishing & Printing	11	17.7	*5*	22.4	*2*	21.9	*4*	4.1	*24*	7.5	*23*	14.7	*8*
Stores	34	11.1	*13*	10.2	*14*	11.1	*10*	12.0	*11*	10.8	*17*	9.9	*15*
Textiles	42	7.6	*18*	2.6	*22*	2.9	*22*	12.2	*10*	12.8	*9*	8.9	*18*
Agencies	3	8.6	*16*	5.7	*18*	0.6	*24*	25.6	*2*	8.2	*22*	7.3	*21*
Chemicals	8	13.1	*12*	18.1	*3*	25.2	*3*	9.2	*17*	11.1	*16*	16.6	*6*
Conglomerates	14	23.5	*3*	16.4	*5*	28.8	*2*	24.0	*3*	18.6	*3*	14.6	*9*
Transport	13	26.1	*2*	33.1	*1*	30.3	*1*	5.0	*21*	9.9	*20*	0.7	*24*
Telephone Networks	1	3.0	*22*	5.1	*19*	11.5	*8*	4.3	*23*	16.6	*6*	8.8	*19*
Miscellaneous	37	3.8	*20*	3.9	*20*	7.7	*16*	13.6	*9*	11.8	*14*	13.8	*11*

FIGURE 1 QUARTILES OF THE LONG–TERM AND SHORT–TERM DEBT RATIOS

The annual quartiles of the long–term and short–term debt ratios for the sample of 444 firms, on book and on market valuation of equity.



3. THE EFFECT OF TAXES

The preoccupation of the tax–based theoretical capital structure literature has been to bound the tax benefits to corporate borrowing given that, in reality, most firms do not borrow the greater part of their funds, and that many firms borrow nothing. In the traditional 'static tradeoff' the tax benefit to financial leverage was balanced by the expected costs of financial distress at an internal optimum. Though the existence of bankruptcy costs will generate an internal optimum capital structure (Kraus and Litzenberger (1973), Scott (1976), Kim (1978)) a realistic assessment suggests that the costs of financial distress are greatly outweighted by the apparent tax benefits (Miller (1977), Myers and Pogue (1974), Jensen and Meckling (1976)). Warner (1977) measured the direct bankruptcy costs for 11 US railway companies and found them to average less than 1% of the market value of the company 7 years previously. The expected value of such costs will be lower still, particularly if acquisition or restructuring offer lower cost exit routes than failure(Jensen and Meckling (1976), Haugen and Senbet (1978)). Hence in Miller's 1977 model tax savings at the corporate level were balanced by personal tax costs generating an aggregate equilibrium but leverage indeterminacy at the firm level. De Angelo and Masulis (1980a) showed that borrowing will be bounded without the need for external constraints and without invoking costs of financial distress if the marginal value of interest tax credits declines with leverage, and if there is uncertainty about the level of taxable profits. Mayer (1986) derived this result for an imputation system of corporate tax and he showed that tax exhaustion on the dividend/new issue margin, which arises when the probability of lost dividend tax credits increases with dividend payout, may generate an internal dividend equilibrium in a similar manner.

In all of these models the effect of tax exhaustion on leverage is unambiguous: tax paying firms should borrow more than tax exhausted firms, other things equal. But attempts to validate this proposition empirically have yielded perverse results. For instance in

Bradley, Jarrell and Kim (1984) the dependent variable was the cross–sectional deviations of debt–equity ratios from target, proxying target by a historic 20–year average debt–to–value measure, for a sample of 821 US firms over 1962 to 1981. Their three explanatory factors were the through–time volatility of firm earnings as a proxy for risk, the intensity of R&D and advertising expenditures proxying the value of growth opportunities, and the amount of non–debt tax shields. They found a strong industry component in average leverage ratios and, as predicted, leverage ratios were inversely related to earnings volatility and to levels of investment in R&D and advertising. But non–debt tax shields had a significant yet perverse sign. Firms with a lower value for interest tax shields had higher leverage. Titman (1984) reported similar results.

3.1 The UK corporate tax system

Under the UK imputation tax system the firm can deduct interest payments at the corporate tax rate, τ_c, and dividends at the basic rate of income tax, τ_m. So for full–payout fully taxpaying firms there is a tax–rate advantage to interest of the 'tax wedge', $\tau_c - \tau_m$. The wedge narrowed significantly after the 1984 Lawson tax reform (Table 4). The marginal incentives change if the firm has a stock of tax losses. In the UK, one year carryback and unlimited carryforward of tax losses was available during the period of this study, and six years carryback (pre–1983, three years) and unlimited carryforward for surplus dividend credits.[6] Taking the deterministic case for simplicity, if a firm will be carrying forward tax losses for p periods, deferral reduces the present value of the tax credit on a marginal \$1 of interest expense to $\tau_c(1+r)^{-p}$ if r is the periodic rate of time–preference. UK firms can recover tax credits on a maximum gross dividend (including credit) equal to taxable profit. Since taxable profit bounds the offset of dividend credits the incidence of dividend exhaustion is rather deeper than for tax losses, that is, it must always hold that $q \geq p$. So if the firm also expects to have surplus

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[6]From 1991 the firm can carry back its tax losses 3 years.

dividend credits for q periods its effective corporate tax rate on the marginal unit of taxable profit is

$$\tau^{*} = \tau_c(1+r)^{-p} - \tau_m[(1+r)^{-p} - (1+r)^{-q}] \tag{1}$$
$$= [\tau_c - \tau_m](1+r)^{-p} + \tau_m(1+r)^{-q}$$

The intuition behind (1) is that a unit of taxable profit is taxed at rate τ_c, p periods hence and permits the firm to bring forward recovery of τ_m of tax from q to p. Since both τ_m and the wedge $\tau_c - \tau_m$ are always set by government to be non–negative the effective tax rate is decreasing in p and q.[7] The specification of the effective tax rate in (1) assumes no dividend effect of the marginal unit of taxable profit. More generally a non–zero marginal dividend payout ratio of DIV adds $DIV.\tau_m[1-(1+r)^{-q}]$ to (1), since the firm must immediately pay a marginal imputation credit of $DIV.\tau_m$ which it can recover at q so that in the full payout case

$$\tau^{*} = \tau_m + [\tau_c - \tau_m](1+r)^{-p},$$

and τ^{*} has a minimum at τ_m. This suggests that τ^{*} is increasing in the dividend payout ratio.

In the existing empirical literature the company's tax position has been proxied by the level of current period non–debt tax deductions. But it is clear from the analysis above that the value of the tax saving from an increment of interest deduction is a function of the firm's accumulated stocks of tax losses and of surplus dividend credits, and of the expected evolution in the variables that drive tax liability profits, investment, and so forth. In this study a detailed model[8] of the UK corporation tax is applied to historic data for each firm to generate estimates of accumulated tax losses, and was then used to forecast tax resumption lags under the simplest assumption that the firm's profits would grow at the rate forecast for the economy from the LBS macroeconomic forecast, and that

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[7]See chapter 2.

[8]This is a calibrated model or programming of the tax rules. For a detailed description see chapter 4.

the firm would retain its current asset and liability structure. Table 5 shows the proportion of the sample which were non–taxpaying through 1970's and 1980's, and their estimated tax resumption lags, p and q, all estimated from the tax model. Tax exhaustion deepened through the 1970's until, in 1980, nearly 47% of quoted firms in the sample were not paying mainstream corporation tax whilst among the unquoted group the proportion was still higher. The number of tax exhausted firms halved between 1980 and 1985, and fell below 10% in 1988. Almost 80% of UK firms had surplus dividend credits in the years 1979–1981. Table 5 forecasts that, of the 47% of firms tax–exhausted in 1980, 16% would pay tax in the following year, 16% in 2 or 3 years, 8% in 4 or 5 years, and 7% sometime after that.

If the firm is choosing between borrowing and new issues of equity the well known condition for a frictionless equilibrium is the 'knife–edge' condition $(1-\tau_d)/(1-\tau_z) = (1-\tau^*)$ where τ_d and τ_z are the personal and capital gains tax rates of the marginal investor. Since we do not have access to investor tax rates it is assumed in this study that all investors have the same personal tax rates. Hence the following testable hypotheses are suggested:

– Firms will borrow more, other things equal, the higher τ^*, that is, the incentive to borrow is decreasing in p and q (the tax and dividend credit resumption lags) and increasing in the statutory tax wedge, $\tau_c-\tau_m$, and in the marginal dividend payout ratio, DIV. In the model estimation the firm's average tax rate is used to proxy DIV.

– An increase in τ^* will lead to an increase in the debt ratio, and vice versa.

– Firms which are uncertain about their effective tax rate will use short–term borrowing.

TABLE 4 UK STATUTORY TAX RATES

In the UK the apparent tax advantage to debt for the full–payout tax paying firm is the 'wedge' between the corporate tax rate, τ_c, and the imputation rate, τ_m, which is the basic rate of income tax. The imputation system was introduced in 1975.

	CT	Imputation	Wedge		CT	Imputation	Wedge
1975	52	35	17	*1983*	45	30	15
1976	52	35	17	*1984*	40	30	10
1977	52	34	18	*1985*	35	30	5
1978	52	33	19	*1986*	35	29	6
1979	52	30	22	*1987*	35	27	8
1980	52	30	22	*1988*	35	25	10
1981	52	30	22	*1989*	35	25	10
1982	52	30	22	*1990*	34	25	9

TABLE 5 MODEL ESTIMATES OF TAX AND DIVIDEND CREDIT EXHAUSTION AND RESUMPTION

Annual estimates of the proportion of those firms in the sample of quoted firms which is used in the model estimation which were mainstream tax exhausted and dividend credit exhausted. Percentages are shown on an equal–weighted basis. Estimates are also shown of the tax resumption lags, p and q, for these firms. The surplus dividend credit estimates start from the introduction of the imputation system in 1975. (Estimates differ slightly from those of Chapter 5, Table 4 because this study uses a subset of that sample due to the different sample survival requirement)

	TAX EXHAUSTION					SURPLUS DIVIDEND CREDITS				
	% tax exhaus –ted	forecast lag to resumption in years percentage of firms: 1	2 to 3	4 to 5	6 or more	% surplus dividend credits	forecast lag to resumption in years percentage of firms: 1	2 to 3	4 to 5	6 or more
1973	7.2%	2.3	2.3	0.5	2.3					
1974	17.8%	8.1	4.3	0.7	4.7					
1975	19.6%	7.2	6.1	0.5	5.9	46.6%	5.6	3.8	1.4	35.8
1976	26.8%	13.3	4.5	1.8	7.2	56.8%	6.5	2.9	1.8	45.5
1977	24.3%	8.6	4.1	4.1	7.7	61.0%	3.2	2.5	2.3	53.2
1978	24.8%	5.6	6.5	4.3	8.3	71.2%	1.8	2.7	5.0	61.7
1979	41.0%	8.8	17.1	6.3	8.8	76.8%	4.1	4.7	9.5	58.6
1980	46.6%	15.5	16.2	7.9	7.0	78.2%	3.8	7.9	15.3	51.1
1981	41.2%	15.5	12.6	9.9	3.2	77.5%	4.5	13.5	15.8	43.7
1982	34.5%	9.5	14.0	7.2	3.8	74.8%	6.5	16.9	14.6	36.7
1983	34.0%	11.9	15.5	3.6	2.9	70.3%	8.3	17.3	14.6	30.0
1984	27.7%	10.1	11.7	3.8	2.0	63.7%	11.3	15.1	12.2	25.2
1985	23.2%	13.1	5.9	1.8	2.5	54.7%	9.0	14.9	8.8	22.1
1986	13.7%	4.5	5.4	0.9	2.9	47.5%	8.3	13.1	5.9	20.3
1987	13.1%	5.6	3.6	0.2	3.6	41.4%	7.9	9.9	4.1	19.6
1988	9.7%	4.5	1.1	0.2	3.8	35.8%	8.1	6.1	2.5	19.1

4 NON–TAX HYPOTHESES

In an empirical test of tax effects on borrowing it is necessary to control for non–tax factors, and this section reviews other factors which have appeared in the literature and describes the empirical proxies used in this study[9]. These factors can be viewed as determinants of the cross–sectional distribution of debt ratios, or in a dynamic setting as determining target debt ratios. A number of papers have found that firms behave as though they do have target debt ratios (Gordon (1962), Modigliani and Miller (1963), Lev (1969), Marsh (1982), Ang (1976)). Ang tested various specifications of the 'adjustment to target debt ratio' process. He found that a model in which there was a partial adjustment of the debt level to a constant target debt–equity ratio best explained the behaviour of US corporations over the period 1960–1974.

Since no unified theory of capital structure choice is available empirical models are necessarily rather ad hoc and include variables that emerge from alternative theoretical frameworks, and other variables included on purely pragmatic grounds. Moreover key variables may be omitted; these issues are discussed further in the next section.

4.1 Profitability

The empirical regularity which appears to confound the static trade–off hypothesis is that profitable firms, which are more likely to be tax–payers, borrow less rather than more. Kester (1986) found that return on assets was the most significant determinant of capital structure in Japan and the US and Baskin (1989) cites a number of studies to this effect. Titman and Wessels (1988), Friend and Hasbrouck (1988), and Friend and Long (1988) report an inverse relationship between leverage and profitability. This seems to require a radically different model. The Myers (1977, 1984) 'pecking–order hypothesis' affords no role to tax rationality or to the costs of financial distress; instead firms prefer to use

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[9]For an excellent recent review of the non–tax literature see Harris and Raviv(1991).

internally generated funds if they are available, and unplanned surpluses or shortfalls of cash are absorbed by a cash stock. If external funding is required, borrowing is preferred to new issues of equity. This pecking–order may reflect increasing transactions costs down the hierarchy; alternatively Myers and Majluf(1984) offer an asymmetric information rationale with the risk of foregoing valuable investment projects increasing down the hierarchy. The fact that equity in one form or the other comes both first and last in the pecking–order may help explain the observed cross– sectional diversity in leverage ratios.

Profitability is proxied in this study by two measures, operating income before interest, tax and depreciation to total assets (OI/TA), and the same numerator to sales (OI/S). Gross of depreciation 'cash flow' is the appropriate measures of the firm's ability to fund its investment internally, and avoid a potential correlation between accounting depreciation and the tax depreciation reflected in the effective tax rate.

4.2 Asset Structure

Conventionally, the linkage between financial structure and asset structure has two strands: firms are believed to be more highly levered the higher the proportion of 'securable' assets they hold, but less likely to borrow against intangibles or 'growth opportunities'. Lower monitoring costs are associated with claims secured on assets with well–established values compared to say 'growth opportunities' (Myers and Majluf (1984), Myers (1977), Galai and Masulis (1976), Jensen and Meckling (1976)). These agency costs may be reduced further if the leverage takes the form of short–term debt or convertibles (Jensen and Meckling (1976), Smith and Warner (1979), Green (1984)). On the other hand, Grossman and Hart (1982) point out that if firms with securable assets are less costly to monitor, and if high borrowing restricts managers' scope for consuming perquisites, stockholders may view securable assets and high borrowing as alternative

disciplines on managers. Empirically an inverse relationship between leverage and intangibles has been shown by Long and Malitz (1985), Bradley Jarrell and Kim (1983), Titman and Wessels (1988), Kim and Sorensen (1986), while Marsh (1982) and Martin and Scott (1974), though not Ferri and Jones (1979), find that leverage is positively associated with the proportion of fixed to total assets.

The level of securable assets is proxied here by the ratio of net tangible fixed assets to total assets at book values (FA/TA), while growth opportunities are proxied by the ratio of the market value of equity to book equity (ME/BE), the ratio of investment in tangible assets to total assets in place (I/TA), and by the growth rate in total assets (dTA). While Titman and Wessels argue rightly in principle for proxying the latter by prospective rather than contemporaneous growth, we find no statistical difference between the performance of the two and use contemporaneous growth to save data points.

4.3 Uniqueness

In Titman (1984) the costs that the firm is likely to impose on its investors, employees and customers in liquidition are higher the more specialised or unique its products. In consequence these stakeholders will seek to reduce the risk of failure by requiring lower debt ratios in such firms. Titman and Wessels (1988) argued that firms whose products had close substitutes would spend less on R&D and on selling and advertising, and would have higher quit rates since employees would have relatively less job–specific human capital; empirically they found that debt ratios were significantly negatively related to 'uniqueness'. They found that smaller firms used significantly more short–term debt than large firms, and profitable firms used relatively less debt, measured on the market value of equity. Titman and Wessels found no evidence for the influence of non–debt tax shields, earnings volatility, collateral value or future growth.

The uniqueness proxies used by Titman and Wessels are largely unavailable in the UK. Selling and advertising expenditure and quit rates are not seperately disclosed by UK firms, nor was R&D expenditure during most of the period of this study. Instead, industry level data were collected on R&D to Sales (R&D). Evidence from industrial economics suggests that differentiation expenditure such as R&D and selling is likely to be associated with higher operating margins, so in this case the profitability measure OI/S may also proxy uniqueness. Finally R&D spend is clearly associated with the creation of growth opportunities. The expected sign of the relationship to borrowing is negative in the uniqueness, profitability and growth opportunities contexts.

4.4 Earnings volatility

If bankruptcy is costly so that the cost of borrowing is increasing in the risk of bankruptcy and this is increasing in the volatility of the firm's returns, firms with volatile returns should borrow less. An alternative argument assumes bankruptcy is costless but notes that the effective tax rate and thus the incentive to borrow is increasing in earnings volatility; this is evident when it is recognised that the government's tax claim has the structure of a (complex) call option.[10]

The empirical evidence is indeterminate. Some studies show that firms with volatile returns borrow less though those results are not always significant (Long and Malitz (1983), Williamson (1981), Titman and Wessels (1988), Kester (1986), Friend and Hasbrouck (1988), Friend and Long (1988) Marsh (1982), Ang (1976)). Ferri and Jones (1979) found no significant relationship, while Toy, Stonehill, Rimmers, Wright and Beckhuisen (1974) and Kim and Sorensen (1986) found that leverage increased with operating risk.

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[10]Kale, Noe and Ramirez(1991) derive a U–shaped debt schedule under appropriate assumptions and under US tax rules by noting that the government is long in the corporate tax claim but short in bond–holder's personal tax.

While the existing literature has used a variety of proxies, earnings volatility is proxied here by the variability of operating income gross of depreciation (VAR(OI)). Since it is functionally independent of interest payments this measure avoids a spurious correlation between debt levels and leveraged earnings variability which may arise when, say, beta is used as a risk measure. A single VAR (OI) was estimated for each firm using the whole available annual data for the firm.

4.5 Size

If smaller firms have more volatile earnings, perhaps because they are less diversified, size may also proxy risk. Furthermore small firms may have proportionally higher issue costs on debt or new equity using than large firms, so size may proxy 'access cost' to capital markets. Studies of new issues of debt and equity by Baxter and Cragg (1970), Martin and Scott (1974) and Taub (1975) found smaller firms more likely to issue equity. Other studies have conflicting findings on size; Kester (1986), Titman and Wessels (1988), Kim and Sorensen (1986) find a positive size effect, while Friend and Lang (1988) and Friend and Hasbrouk (1988) found a negative effect.

Size is proxied in this study by the natural log of sales (LN(S)) and of total assets (LN(TA)), measured over the prior three–year period.

5 EMPIRICAL ANALYSIS AND RESULTS

Cross–sectional models of the debt ratio are estimated for three sub–periods, 1975–1977, 1980–1982, and 1985–1987. To reduce the impact of measurement error in variables the model uses the arithmetic mean of each variable over the three–year period and to give a consistent comparison between sub–periods the dataset was restricted to 444 quoted firms with a full series of accounting and share price data from 1972 to 1988. Though we have a large panel of data available for 444 firms over a 17–year period, we choose to estimate the debt models as a series of discrete cross–sections. There were several motives for this. The prime one was to permit a direct comparison with the existing literature, notably the study by Titman and Wessels, which is similar in modus operandi. Moreover the model under review does not contain explicit dynamics. There was also a concern to see if there is some stability in the debt equations measured over different periods. As will be seen below this appears to be the case, suggesting that a pooled model could be successfully estimated as a next stage.

Models are estimated for long term (L), short term (S), and total (T) debt ratios, measured on book (B) and on market equity (E). Since a small number of outliers at the upper tail of the debt/equity distribution significantly reduces both the power and stability of least–squares regressions the denominator of the debt ratio was transformed to debt plus equity for estimation.

The discussion in the previous two sections suggests that the firm's debt ratio will be a function of tax position, profitability (OI/S, OI/TA), uniqueness (OI/S, R&D), size (LN(S), LN(TA)), earnings volatility (VAR (OI)), and asset structure (FA/TA, ME/BE, I/TA, dTA, R&D). In the estimated models, total assets was marginally preferred as a measure of size and is used alone in the models reported below. Three factors determine effective tax rates cross–sectionally: the forecast tax resumption lag, p, the forecast

further lag for dividend credit resumption q–p, and the average dividend payout proxying the marginal payout ratio, DIV. These factors were entered independently in the regressions so as not to impose the theoretical form of the effective tax rate as an additional restriction on the model. Both p and q were forecast on the assumption that the firm maintained its prior level of interest payments so should be independent of capital structure. Table 8 shows the gross correlation matrices for these variables.

Table 6 shows the six models for each of the three periods estimated using least squares. Initially models are estimated in levels and without a lagged dependent variable.

All models are significant in all periods, though with R^2 generally highest in the earlier period. Where the equations defined on market have higher R^2 than those defined on book they also have markedly higher standard errors. There is little to choose between the models estimated on market and book equity except for the significant role of the valuation ratio in the market equations. The valuation ratio enters with the predicted negative sign embodying the unsurprising result that borrowing does not rise in proportion to market capitalisation. Most existing research has used book values, some exceptions are Taggart (1977), Marsh (1982) and Titman and Wessels (1988). These authors found little difference between book and market specifications of the gearing ratio in empirical tests. In the subsequent discussion and interpretation the references are therefore restricted to the book debt ratios.

The estimated models were tested for stability using a Chow test on randomly chosen subgroups, and for heteroscedasticity using an F–test for constancy of variance across sub–groups comprising the larger and smaller firms on the sample. The assumption of homoscedasticity is breached by a number of the equations and accordingly White

heteroscedasticity–consistent estimators are reported in Tables 6 and 7.[11] The Chi2 and significance of the Chow test are reported for all equations. It can be seen that equations are generally stable, the main exception being the long–term, and thus total, debt equations, particularily when a lagged dependant variable is present in the second and third periods. Logging the dependent variable restores stability, as can be seen from the Chows of the logged equations which are also quoted for comparison in the third period. Since the relative performanec of the independent variables is not affected we report the estimated equations in unlogged form.

5.1 Levels of borrowing cross–sectionally

Total debt is strongly positively related to size in all periods – large firms borrow more. However considerable insight is provided by the seperate models for long and short term debt. As was suggested by the aggregate data described in Section 2, though size is a significant determinant of long term debt ratios it is unrelated to short term borrowing behaviour.

By contrast profitability measured by return on assets is, as predicted, significantly negatively related to both long and short term borrowing but only in the first period. Profitability measured by margin is a consistent predictor of short term debt ratio, but not of long term. Since return on total assets tends to be inversely correlated to total assets margin may be a more reliable measure of profitability when total assets is being used as a size proxy, but reestimation of the models with and without each profitability measure did not suggest that margin and return on assets can be treated as substitutes.

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[11]Where significant, the heteroscedasticity in no cases recorded F above 2. Conventionally heteroscedasticity may be reduced by transforming either or both of the dependent or independent variables, though such transformations typically do some violence to the economic interpretation of the estimated model. In this case none of a number of transformations made a significant improvement to heteroscedasticity.

Proxies for the firm's tax position are highly significant in the short–term equations, in the first two periods in the form of the tax exhaustion measure, p, and in the third period as the surplus dividend credit, q–p. This shift is consistent with the changed nature of firm's tax positions after the 1984 tax reforms: the middle period was at the height of the tax exhaustion phenomenon when cross–sectional diversity in effective tax rates was at its greatest whilst by the third period significantly less firms were tax exhausted, though a number continued to carry surplus dividend credits. For long term borrowing the tax lag variables only enter in the second period. However the tax measures are in all cases wrongly signed. Firms with low effective tax rates (high p, q) borrow more not less. The third tax proxy, dividend payout, is significant for short–term borrowing but is unstable in sign; the inconsistency of sign with the other tax measures suggests merely that it is not working as a tax proxy.

The relative sophistication of the measures of tax exhaustion used in this paper appears to have simply strengthened the classic finding that non–taxpaying firms borrow more. The estimates of tax resumption lags and of the effective tax rate embody forecasts of profitability. It seems likely that effective tax rates are acting as lead indicators of financial condition. Moreover the effective tax rate is not independent of the debt–ratio there is a potential problem of simultaneity in these equations. To test these the regressions were rerun using measures of the stock of tax losses, and the stock of surplus dividend credits, both normalised on total assets; at the end of the previous period, and with no loss carryback in place. These are measures of tax position which are independent of the observed debt ratio and with the elements of urrent and forecast profitability stripped out. Though the resulting equations are not reported here the R^2 for these equations is usually slightly reduced as is the t–statistic for the tax proxy, with the main effect on the other coefficients being an increase in the significance of profitability measured by return on assets. Indeed when tax loss stocks are used as tax

proxies the puzzling absence of return on assets in the middle period equations is remedied, and return on assets is significant in all periods.

The role of two factors, risk and uniqueness, is intriguing. Earnings volatility was significant in two out of three periods both for long and short term borrowing. In all cases, however, it enters the equation with a positive coefficient. Firms with more volatile earnings borrow more. Pairwise, earnings volatility is inversely correlated with the profitability measures and with the effective tax rate and the dominant and observable role of the risk measure appears to be as an indicator of financial condition The uniqueness proxy – two digit industry averages of R&D spend to sales – is significant in all the total debt equations and in almost all the short term and long term equations, and counter to 'uniqueness' theory is positive in all cases. Inspection of the gross correlation matrices suggests that R&D is positively correlated with both profitability measures and inversely correlated to the tangible assets ratio, FA/TA. As would be expected if it is proxying growth opportunities, it is positively correlated with the valuation ratio. It is possible that, rather than uniqueness, R&D is proxying the firm's ability to leverage its intangible assets.

In all periods there is a strong, significant and, as predicted, positive relationship between long–term borrowing and the proportion of fixed assets in total assets. By contrast when it is significant short–term debt is negatively related to the fixed assets ratio. As noted the valuation ratio (ME/BE) was significantly and negatively related to both market gearing ratios in all but one period, but not with book ratios. The two proxies for growth opportunities, prospective growth in assets, and the investment level, were inconsistent both in sign and significance.

5.2 Changes in borrowing cross–sectionally

The models were re–estimated with the inclusion of a lagged dependent variable, which was the average debt ratio for the prior three–year period. This permits the assessment of the influence of the independent variables on changes in capital structure, particularly the influence of the tax position proxies. By taking a three–year lag it should be possible to observe interactions, if they exist, even if there are costs to adjusting capital structure. Table 7 displays the revised models. The entry of the lagged dependent variable reduces the significance of the remaining independent variables though without changing the sign on coefficents and in this sense the estimated models appear robust. Some variables drop out: margin and risk no longer explain short–term borrowing in the presence of lagged borrowing, while R&D and Fixed to total assets are no longer significant in the long–term equations. The variables which continue to perform and are significant in explaining changes in debt ratios are size, for long–term debt, profitability measured by return on assets for long term and particularily for short term where it has a higher t–statistic in most periods, and to some extent the tax resumption lag, p, though again with perverse sign.

It was hypothesised that firms would change capital structure in response to a change in effective tax rate. To test for evidence of this the lagged dependent models were rerun but with the inclusion of an additional term measuring the change in the firm's effective tax rate over the last three years. (These equations are not reported seperately.) The additional term was significant in broadly those equations were the tax resumption lag was significant, but in all cases with consistent sign – firms increase their borrowing when their effective tax rate falls.

6 CONCLUSIONS

This study has shown the following:

The distinction between short and long term borrowing is empirically significant and there are distinct profiles for these two elements of corporate debt. Firms borrow long term when they are larger, less profitable in terms of return on assets, and when they have securable (=fixed) assets. Size is not a determinant of short term borrowing. Firms borrow short term when they have low return on assets and low margins, and when they have a low effective tax rate.

Overall corporate debt levels mainly reflect size and (lack of) profitability, the latter consistent with Myers' 'pecking–order'.

The profitabilty/borrowing nexus is indeed so powerful as to reverse two predictions of conventional theory. Firms with higher business risk borrow more. Moreover the firm's effective tax rate is a good predictor of debt ratios, but with perverse sign.

Non–taxpaying firms borrow more. The firm's effective tax rate, and to a lesser extent its business risk, are inversely correlated with profitability and apparently proxy financial condition.

In this study R&D expenditure is a positive predictor of borrowing, counter to the predictions of 'uniqueness' theory. A picture of the relationship between asset structure emerges in which firms are able to borrow long term when they have fixed asset backing, and are less likely to borrow against market equity but are able to leverage growth opportunities in the associate with R&D expenditure.

Debt ratios measured on market equity add nothing to those based on book empirically.

TABLE 6 ESTIMATED MODELS – LEVELS

		1975–1977		1980–1982		1985–1987		1975–1977		1980–1982		1985–1987	
LONG TERM DEBT				*BOOK*						*MARKET*			
		B	t	B	t	B	t	B	t	B	t	B	t
Total assets	LN(TA)	0.034	9.3	0.038	11.7	0.029	9.5	0.041	7.0	0.050	10.2	0.023	7.8
Profitability	OI/TA	−0.519	−2.9	0.049	0.1	−0.185	−1.0	−0.658	−1.9	0.250	0.6	−0.069	−0.4
Margin	OI/S	−0.048	−0.3	0.134	0.9	−0.100	−0.7	−0.017	−0.1	0.125	0.6	0.006	0.1
Tax lag	p	0.001	0.9	0.005	2.7	0	0.1	0.002	0.8	0.008	2.6	0	0.3
Div. Cred. lag	q−p	0.001	0.9	0.004	3.4	0.004	2.6	0.003	1.2	0.004	1.7	0.003	1.9
Risk	VAR(OI)	0.020	1.0	0.018	1.4	0.028	1.4	0.033	1.4	0.021	0.9	0.043	2.0
Dividend payout	DIV	−0.036	−1.2	0.007	0.6	−0.004	−0.3	−0.069	−1.2	0.051	2.8	0.009	0.7
R&D	R&D	0.026	4.2	0.007	1.2	0.019	3.1	0.043	4.3	0.024	2.4	0.021	3.5
Fixed/total assets	FA/TA	0.16	3.7	0.085	2.8	0.089	3.2	0.274	4.0	0.184	3.4	0.089	2.9
Invest/total assets	I/TA	−0.084	−1.2	−0.118	−2.1	0.072	1.1	−0.054	−0.4	−0.246	−2.4	0.061	0.9
Growth	dTA	−0.086	−1.9	−0.061	−2.0	0.045	1.4	−0.161	−2.3	−0.084	−1.5	0.031	1.3
Valuation Ratio	ME/BE	0.041	3.4	−0.001	−0.1	0.021	2.2	−0.095	−4.2	−0.098	−5.6	−0.035	−4.1
Constant		−0.121	−1.7	−0.255	−5.6	−0.323	−5.7	0.027	0.3	−0.281	−3.5	−0.214	−4.5
	Adj R2	0.390		0.307		0.260		0.345		0.350		0.233	
	SE	0.091		0.090		0.092		0.154		0.148		0.233	
	F	24.7		17.3		13.9		20.5		20.9		12.2	
Chow (Chi2;sig)		17.2	0.19	16.2	0.24	31.5	0.00	19.3	0.11	22.4	0.05	30.9	0.00
Chow (Chi2;sig) using logged dependent variable						21.5	0.06					18.4	0.15
SHORT_TERM DEBT				*BOOK*						*MARKET*			
Total assets	LN(TA)	−0.004	−0.9	0.004	0.8	0.002	0.5	−0.011	−1.9	0.007	1.2	0.010	0.2
Profitability	OI/TA	−0.593	−3.1	0.405	1.4	−0.300	−1.2	−0.794	−2.7	0.487	1.2	−0.198	−0.9
Margin	OI/S	−0.622	−4.3	−0.608	−3.9	−0.458	−3.0	−0.74	−3.5	−0.738	−3.5	−0.324	−2.1
Tax lag	p	0.007	3.7	0.010	3.8	0.004	1.5	0.010	3.5	0.016	4.3	0.003	1.1
Div. Cred. lag	q−p	0.001	0.7	0.003	1.5	0.006	3.1	0.002	0.8	0.001	0.2	0.003	2.0
Risk	VAR(OI)	0.005	0.3	0.042	2.2	0.05	2.1	0.017	0.6	0.033	1.2	0.049	2.1
Dividend	DIV	−0.083	−2.4	0.039	2.3	−0.038	−1.7	−0.096	−1.9	0.092	3.9	−0.044	−2.1
R&D	R&D	0.02	2.8	0.031	4.1	0.017	2.2	0.033	3.1	0.050	4.4	0.022	2.7
Fixed/total assets	FA/TA	−0.116	−2.9	−0.029	−0.8	−0.116	−3.2	−0.123	−1.8	0.011	0.2	−0.133	−3.3
Invest/total assets	I/TA	−0.106	−1.5	−0.061	−0.7	0.135	1.2	−0.065	−0.5	−0.21	−1.6	0.159	1.6
Growth	dTA	−0.08	−1.4	−0.002	−0.1	0.035	0.9	−0.153	−2.2	−0.018	−0.4	0.018	0.5
Valuation Ratio	ME/BE	0.037	2.7	−0.018	−1.5	0.019	1.6	−0.12	−4.1	−0.121	−5.9	−0.054	−4.7
Constant		0.466	5.1	0.113	−0.1	0.153	2.2	0.849	6.9	0.244	2.8	0.245	3.4
	Adj R2	0.329		0.266		0.261		0.410		0.400		0.255	
	SE	0.106		0.115		0.123		0.150		0.173		0.125	
	F	19.1		14.4		14.0		26.6		25.6		13.7	
Chow (Chi2;sig)		16.9	0.21	12.6	0.48	25.4	0.02	13.6	0.40	7.8	0.86	15.5	0.28
Chow (Chi2;sig) using logged dependent variable						18.7	0.13					19.4	0.11
TOTAL DEBT				*BOOK*						*MARKET*			
Total assets	LN(TA)	0.031	4.9	0.041	7.1	0.031	6.3	0.030	2.9	0.057	6.5	0.024	4.7
Profitability	OI/TA	−1.113	−4.0	0.454	0.9	−0.485	−1.3	−1.452	−2.7	0.737	1.1	−0.267	−0.9
Margin	OI/S	−0.67	−2.8	−0.474	−1.8	−0.558	−2.4	−0.758	−1.7	−0.612	−1.6	−0.318	−1.4
Tax lag	p	0.008	2.9	0.015	3.8	0.005	1.2	0.012	2.5	0.024	4.0	0.004	1.0
Div. Cred. lag	q−p	0.002	1.0	0.007	2.8	0.009	3.5	0.004	1.2	0.004	1.0	0.006	2.4
Risk	VAR(OI)	0.018	0.7	0.061	2.4	0.078	2.4	0.049	1.1	0.054	1.2	0.092	3.1
Dividend	DIV	−0.119	−2.0	0.045	2.0	−0.042	−1.5	−0.165	−1.7	0.143	4.0	−0.035	−1.3
R&D	R&D	0.046	4.4	0.038	3.6	0.036	3.2	0.076	4.3	0.074	4.1	0.043	3.7
Fixed/total assets	FA/TA	0.043	0.7	0.056	1.0	−0.027	−0.5	0.151	1.4	0.194	1.9	−0.044	−0.8
Invest/total assets	I/TA	−0.190	−1.8	−0.179	−1.7	0.207	1.3	−0.118	−0.5	−0.455	−2.5	0.22	1.5
Growth	dTA	−0.166	−1.9	−0.062	−1.2	0.079	1.2	−0.313	−2.6	−0.102	−1.2	0.049	0.9
Valuation Ratio	ME/BE	0.079	4.0	−0.019	−1.0	0.040	2.1	−0.215	−4.6	−0.219	−6.3	−0.089	−5.2
Constant		0.344	2.6	−0.142	−1.5	−0.171	−1.5	0.877	4.3	−0.036	−0.1	0.030	0.3
	Adj R2	0.362		0.268		0.266		0.403		0.420		0.262	
	SE	0.154		0.163		0.169		0.263		0.420		0.172	
	F	21.9		14.5		14.4		25.9		27.7		14.1	
Chow (Chi2;sig)		14.6	0.33	11.6	0.56	27.7	0.01	15.3	0.29	12.9	0.45	18.4	0.14
Chow (Chi2;sig) using logged dependent variable						20.1	0.09					16.9	0.21

TABLE 7 ESTIMATED MODELS – CHANGES

		1975–1977		1980–1982		1985–1987		1975–1977		1980–1982		1985–1987	
LONG TERM DEBT					*BOOK*						*MARKET*		
		B	t	B	t	B	t	B	t	B	t	B	t
Lagged debt ratio	D–1	0.746	21.6	0.579	8.8	0.437	8.4	0.768	21.9	0.662	14.1	0.309	7.9
Total assets	LN(TA)	0.006	2.6	0.017	5.0	0.015	4.6	0.010	2.8	0.019	4.3	0.012	4.2
Profitability	OI/TA	−0.215	−2.0	−0.023	−0.2	−0.308	−1.7	−0.18	−1.1	0.001	0.0	−0.185	−1.3
Margin	OI/S	0.003	0.0	0.164	1.6	−0.046	−0.4	−0.145	−1.2	0.182	1.4	0.057	0.6
Tax lag	p	0.002	1.5	0.003	2.3	−0.001	−0.6	0.003	1.4	0.005	2.3	−0.002	−1.1
Div. Cred. lag	q–p	0.000	−0.3	0.003	2.7	0.001	1.1	0	0.5	0.003	1.5	0	0.1
Risk	VAR(OI)	0.010	1.2	−0.001	−0.1	0.018	1.0	0.014	0.8	−0.020	−1.0	0.045	2.1
Dividend payout	DIV	0.010	0.6	0.011	1.1	0.003	0.2	0.024	0.6	0.045	2.9	0.025	1.6
R&D	R&D	0.006	1.5	−0.003	−0.7	0.014	2.6	0.006	1.1	0.003	0.4	0.016	3.1
Fixed/total assets	FA/TA	0.012	0.6	0.024	1.0	0.077	3.0	0.067	1.9	0.076	2.0	0.081	2.8
Invest/total assets	I/TA	−0.061	−1.6	−0.043	−0.9	0.052	1.1	−0.038	−0.4	−0.169	−2.3	0.018	0.3
Growth	dTA	−0.032	−1.0	−0.053	−1.9	0.044	1.4	−0.064	−1.0	−0.116	−2.2	0.023	1.0
Valuation Ratio	ME/BE	0.018	1.8	0.001	0.1	0.021	2.5	−0.032	2.0	−0.040	−2.9	−0.021	−3.1
Constant		0.007	0.2	−0.080	−1.7	−0.208	−3.6	0.053	0.6	0.007	0.1	−0.171	−3.7
	Adj R2	0.774		0.534		0.456		0.721		0.623		0.439	
	SE	0.055		0.074		0.079		0.100		0.112		0.078	
	F	117.8		40.1		29.6		89.2		57.4		27.7	
Chow (Chi2;sig)		15.8	0.32	34.8	0.00	56.9	0.00	10.5	0.73	39.8	0.00	38.5	0.00
Chow (Chi2;sig) using logged dependent variable						21.2	0.10					18.2	0.20
SHORT_TERM DEBT					*BOOK*						*MARKET*		
Lagged debt ratio	D–1	0.665	17.2	0.806	20.1	0.573	9.6	0.71	17.1	0.735	20.5	0.38	9.4
Total assets	LN(TA)	−0.006	−2.6	−0.001	−0.7	0.002	0.7	−0.008	−2.2	0.002	0.3	0.002	0.6
Profitability	OI/TA	−0.588	−4.4	−0.250	−2.0	−0.771	−4.3	−0.747	−3.3	−0.204	−1.0	−0.559	−3.3
Margin	OI/S	−0.021	−0.2	−0.012	−0.1	−0.104	−0.8	−0.14	−0.8	−0.024	−0.1	−0.007	−0.1
Tax lag	p	0.003	2.4	0.003	2.0	0.000	−0.2	0.005	2.1	0.007	3.0	−0.002	−0.8
Div. Cred. lag	q–p	0	−0.2	−0.001	−0.6	0.001	0.7	0	0.3	−0.001	−0.7	0	−0.2
Risk	VAR(OI)	−0.01	−1.1	0.019	1.4	0.014	0.6	−0.028	−1.3	0.001	0.0	0.042	2.0
Dividend	DIV	−0.014	−0.8	0.044	3.6	0.004	0.2	0.017	0.5	0.095	5.1	0.003	0.1
R&D	R&D	0.005	1.2	0.015	2.7	0.003	0.5	0.005	0.7	0.025	3.1	0.01	1.7
Fixed/total assets	FA/TA	−0.052	−2.2	0.022	1.0	−0.064	−2.2	−0.063	−1.5	0.075	2.1	−0.084	−2.4
Invest/total assets	I/TA	−0.019	−0.4	−0.015	−0.3	0.102	1.3	0.007	0.1	−0.204	−2.1	0.086	1.2
Growth	dTA	−0.077	−1.6	−0.009	−0.3	0.021	0.5	−0.094	−1.5	−0.066	−1.5	0.002	0.1
Valuation Ratio	ME/BE	0.027	2.7	−0.004	−0.4	0.035	3.8	−0.026	−1.6	−0.050	−3.4	−0.020	−2.6
Constant		0.274	4.5	0.041	0.9	0.034	0.5	0.429	4.4	0.139	2.0	0.076	1.2
	Adj R2	0.701		0.657		0.506		0.700		0.693		0.459	
	SE	0.071		0.079		0.100		0.117		0.123		0.107	
	F	80.9		66.3		35.9		80.7		77.9		30.0	
Chow (Chi2;sig)		27.6	0.02	10.0	0.76	24.5	0.04	20.1	0.13	4.9	0.99	18.5	0.19
Chow (Chi2;sig) using logged dependent variable						23.2	0.06					20.6	0.11
TOTAL DEBT					*BOOK*						*MARKET*		
Lagged debt ratio	D–1	0.736	20.5	0.736	12.2	0.449	6.9	0.766	19.0	0.712	20.0	0.303	7.5
Total assets	LN(TA)	0.000	0.0	0.01	2.3	0.017	3.5	0.003	0.4	0.018	2.9	0.014	3.1
Profitability	OI/TA	−0.806	−4.2	−0.236	−1.0	−0.981	−3.2	−0.924	−2.7	−0.200	−0.6	−0.667	−2.6
Margin	OI/S	0.045	0.3	0.108	0.8	−0.225	−1.2	−0.237	−0.8	0.139	0.6	−0.016	−0.1
Tax lag	p	0.004	2.4	0.006	2.8	−0.001	−0.2	0.007	2.0	0.011	3.2	−0.003	−0.8
Div. Cred. lag	q–p	0	−0.4	0.002	1.3	0.003	1.4	0.001	0.4	0.002	0.5	0.001	0.3
Risk	VAR(OI)	−0.005	−0.3	0.015	0.7	0.040	1.3	−0.018	−0.5	−0.022	−0.7	0.089	3.0
Dividend	DIV	0.002	0.0	0.056	3.1	−0.003	−0.1	0.05	0.8	0.140	4.9	0.018	0.7
R&D	R&D	0.01	1.6	0.010	1.4	0.02	2.2	0.01	0.9	0.027	2.3	0.028	3.1
Fixed/total assets	FA/TA	−0.031	−0.9	0.025	0.7	0.002	0.1	0.009	0.1	0.141	2.4	−0.013	−0.2
Invest/total assets	I/TA	−0.071	−1.0	−0.042	−0.5	0.161	1.3	−0.026	−0.1	−0.368	−2.6	0.12	1.1
Growth	dTA	−0.109	−1.6	−0.059	−1.4	0.068	1.1	−0.154	−1.3	−0.183	−2.1	0.029	0.6
Valuation Ratio	ME/BE	0.044	2.8	−0.004	−0.2	0.053	3.3	−0.051	−2.0	−0.089	−3.4	−0.048	−3.9
Constant		0.259	2.8	0.015	0.3	−0.154	−1.5	0.449	2.6	0.171	1.5	−0.062	−0.7
	Adj R2	0.752		0.631		0.444		0.723		0.708		0.433	
	SE	0.096		0.116		0.147		0.179		0.188		0.151	
	F	104.6		59.2		28.2		90.0		83.7		27.0	
Chow (Chi2;sig)		31.8	0.00	15.8	0.33	37.0	0.00	18.6	0.18	16.5	0.29	23.4	0.05
Chow (Chi2;sig) using logged dependent variable						24.6	0.04					18.7	0.18

TABLE 8 GROSS CORRELATION MATRICES

CORRELATIONS 1975–1977

	LT/BE	ST/BE	LT/ME	ST/ME	LN (S)	LN (TS)	OI/S	OI/TA	I*	P	q–p	DIV	INV/TA	FA/TA	VAR (OI)	R&D	ME/BE	dTA
ST/BE	0.147																	
LT/ME	0.595	0.119																
ST/ME	0.079	0.643	0.446															
LN (S)	0.369	-0.008	0.161	-0.036														
LN (TS)	0.342	-0.058	0.182	-0.061	0.675													
OI/S	-0.076	-0.333	-0.116	-0.280	-0.116	0.080												
OI/TA	-0.300	-0.323	-0.356	-0.346	-0.106	-0.077	0.528											
I*	-0.153	-0.325	-0.163	-0.319	0.065	0.036	0.371	0.574										
P	0.112	0.327	0.154	0.313	-0.129	-0.089	-0.274	-0.429	-0.843									
q–p	0.087	0.112	0.088	0.110	0.043	0.016	-0.229	-0.338	-0.668	-0.094								
DIV	0.239	0.001	0.232	0.056	-0.066	-0.016	-0.009	-0.213	-0.093	0.002	0.120							
INV/TA	-0.003	-0.184	-0.044	-0.156	0.002	-0.050	0.244	0.152	0.037	0.009	-0.049	0.027						
FA/TA	0.140	-0.216	0.162	-0.075	0.017	0.072	0.171	-0.085	0.085	-0.003	-0.057	0.126	0.409					
VAR (OI)	0.009	0.083	0.079	0.066	-0.200	-0.137	-0.125	-0.153	-0.128	0.143	0.036	0.083	0.057	-0.017				
R&D	0.059	0.003	-0.027	-0.050	0.107	0.064	0.077	0.105	0.006	-0.042	0.041	-0.049	0.006	-0.202	-0.030			
ME/BE	-0.030	-0.128	-0.309	-0.333	0.101	0.036	0.259	0.552	0.274	-0.187	-0.166	-0.052	0.134	0.006	-0.074	0.165		
dTA	-0.200	-0.183	-0.223	-0.235	-0.096	-0.121	0.131	0.436	0.174	-0.166	-0.051	-0.204	0.122	-0.031	-0.005	0.025	0.307	

CORRELATIONS 1980–1982

	LT/BE	ST/BE	LT/ME	ST/ME	LN (S)	LN (TS)	OI/S	OI/TA	I*	P	q–p	DIV	INV/TA	FA/TA	VAR (OI)	R&D	ME/BE	dTA
ST/BE	0.281																	
LT/ME	0.642	0.187																
ST/ME	0.052	0.475	0.274															
LN (S)	0.324	-0.045	0.153	-0.046														
LN (TS)	0.231	-0.094	0.111	-0.066	0.674													
OI/S	-0.048	-0.279	-0.152	-0.205	-0.050	0.120												
OI/TA	-0.132	-0.286	-0.250	-0.259	0.172	0.118	0.601											
I*	-0.223	-0.395	-0.289	-0.284	0.190	0.114	0.380	0.676										
P	0.208	0.390	0.285	0.305	-0.236	-0.131	-0.287	-0.488	-0.740									
q–p	0.119	0.162	0.103	0.088	0.027	-0.011	-0.255	-0.434	-0.805	-0.051								
DIV	0.089	0.345	0.156	0.231	-0.089	-0.066	-0.285	-0.395	-0.281	0.174	0.189							
INV/TA	-0.029	-0.134	-0.114	-0.122	0.016	0.016	0.336	0.241	0.209	-0.130	-0.171	-0.072						
FA/TA	0.072	-0.151	0.040	-0.050	0.021	0.095	0.239	0.011	0.110	-0.088	-0.120	0.013	0.458					
VAR (OI)	-0.002	0.108	-0.039	0.018	-0.199	-0.137	-0.075	-0.113	-0.093	0.138	-0.044	0.118	0.025	-0.010				
R&D	-0.003	0.003	-0.067	-0.037	0.103	0.069	0.142	0.220	0.096	-0.095	-0.037	-0.038	-0.004	-0.191	-0.028			
ME/BE	-0.068	-0.149	-0.301	-0.252	0.129	0.068	0.353	0.637	0.412	-0.256	-0.329	-0.186	0.172	-0.020	0.092	0.419		
dTA	-0.137	-0.151	-0.208	-0.134	-0.041	0.025	0.280	0.330	0.290	-0.182	-0.219	-0.181	0.273	0.150	0.158	0.000	0.338	

CORRELATIONS 1985–1987

	LT/BE	ST/BE	LT/ME	ST/ME	LN (S)	LN (TS)	OI/S	OI/TA	I*	P	q–p	DIV	INV/TA	FA/TA	VAR (OI)	R&D	ME/BE	dTA
ST/BE	0.473																	
LT/ME	0.639	0.161																
ST/ME	0.115	0.495	0.285															
LN (S)	0.179	-0.132	0.142	-0.047														
LN (TS)	0.142	-0.076	0.091	-0.079	0.611													
OI/S	0.094	-0.166	0.068	-0.201	0.076	0.187												
OI/TA	-0.105	-0.162	-0.205	-0.232	0.230	0.106	0.500											
I*	-0.089	-0.158	-0.085	-0.141	0.214	0.082	0.307	0.546										
P	0.105	0.229	0.086	0.130	-0.282	-0.103	-0.257	-0.447	-0.818									
q–p	0.050	0.033	0.044	0.083	-0.047	-0.027	-0.202	-0.371	-0.806	0.059								
DIV	-0.005	-0.054	0.041	-0.040	-0.047	-0.023	-0.016	-0.162	-0.142	0.036	0.125							
INV/TA	0.057	0.021	-0.009	-0.028	0.013	0.002	0.127	0.043	0.056	-0.102	-0.021	0.017						
FA/TA	0.033	-0.043	0.076	-0.059	-0.015	0.025	0.051	-0.124	-0.107	0.160	0.015	0.033	0.115					
VAR (OI)	0.263	0.253	0.202	0.025	-0.172	-0.096	-0.099	-0.148	-0.066	0.210	-0.057	-0.074	0.109	0.078				
R&D	0.027	0.006	-0.017	-0.003	0.136	0.066	0.116	0.156	0.067	-0.050	-0.040	-0.045	-0.036	-0.124	-0.031			
ME/BE	0.191	0.215	-0.230	-0.211	0.057	0.012	0.182	0.416	0.112	0.048	-0.173	-0.079	0.171	-0.111	0.242	0.185		
dTA	0.136	0.248	-0.040	0.023	-0.273	-0.108	-0.011	-0.052	0.016	-0.033	-0.023	-0.095	0.169	-0.071	0.440	-0.059	0.208	

APPENDIX Components of FTA Actuaries Industry Groups

1 Builders merchants, Timber, Bricks and roofing tiles, Paint, Cement and concrete, Building materials
2 Heating and ventilating, Contracting and construction
3 Electricals (not radio & TV)
4 Electricals (domestic)
5 Founders and stampers
6 Machine & other tools, Miscellaneous mechanical engineering, Miscellaneous engineering contractors, Pumps and valves, Steel & chemical plant, Mechanical handling (cranes), Wires and ropes, Industrial plant engines
7 Miscellaneous Metal forming (Special steels, Metallurgy)
8 Motor components, Motor distributors, Motor vehicles
9 Instruments, Other industrial materials
10 Breweries, Wines & spirits
11 General food manufacturing, Milling and flour, Confectionary.
12 Food retailing
13 Pharmaceuticals
14 Hotels & caterers, Leisure, Radio & TV
15 Packaging & paper,
16 Publishing & printing, Newspapers & periodicals
17 Multiple stores, Furnishing stores, Mail–order stores, Department stores
18 Misc. textiles, Clothing, Floor covering, Wool, Cotton & synthetic
19 Agencies
20 General chemicals, Plastic & rubber fabrications
21 Industrial holding (conglomerates)
22 Transport & freight
23 Utilities
24 Waterworks
25 Miscellaneous, Shipping, Office equipment, Footwear, Household appliances, Furniture and bedding, Kitchen & tableware, Tobacco, Laundries & cleaners
26 Oil

CHAPTER 7

DETERMINANTS OF THE MEANS OF PAYMENT IN MERGERS AND ACQUISITIONS

During the UK merger wave of the mid 1980s there was a significant increase in the proportion of equity financed bids. A common explanation at the time was the beneficial accounting treatment available after an equity bid, though these benefits appear to have been largely cosmetic. The paper tests the accounting explanation against other hypotheses on the determinants of the consideration in takeovers during the decade to 1987. We find that accounting rules and the 'timing' factors of recent returns on the bidder's stock and conditions in the equity market were significant determinants of the consideration issued by bidders. Moreover cash was more likely to be used when bidders were liquid. Neither the hostility of the bid nor capital gains taxes were significant in explaining the consideration issued by bidders.

1 INTRODUCTION

We still have no satisfactory explanation for the financing of mergers and acquisitions, despite the fact that there have been real and sometimes puzzling shifts in the form of the consideration issued by bidders. For instance, in the mid 1980s there was a significant increase in the proportion of equity financed bids in the UK. Whilst through the 1970s over 60% of UK bids were financed by cash and a little over 30% by equity, between 1985 and 1987 only 32.7% were cash financed against 57.5% equity. In the US, by contrast, cash acquisitions had increased steadily from a negligible proportion of all acquisitions in the 1950s to over 60% by the 1980s (Franks, Harris and Mayer (1988)). The shift to equity bids in the UK coincided with a wave of merger activity and with a buoyant stock market, but also with a period when the corporate sector was particularly liquid. Though the merger wave continued unabated after the October 1987 crash, the proportion of equity bids fell dramatically from 69% in 1987 to 21% in 1988.

This paper attempts to provide an empirical explanation for this phenomenon. Existing research has consistently found higher bid premia in bids where vendors are offered cash, and theory has focused almost entirely on explaining these bid premia in terms of tax and information asymmetries. The approach of this paper differs from the existing literature in several important respects. It makes a distinction between the means of payment offered to the vendors and issued by the bidder, which is the dependent variable for this study. Issued and offered can differ when there is intermediation; for instance when third parties provide an underwritten cash alternative to an equity bid. Shifting the focus to issued consideration suggests a different set of explanatory factors. Firstly an accounting explanation is proposed for the use of equity in some cases. The provision of a cash alternative from whatever source may be transactions cost and capital gains tax efficient for vendors, but Heinkel and Schwartz (1985) point out that a cash alternative underwritten by a third party may provide external validation of the offer by an informed trader. The present paper identifies another role for the cash alternative underwritten by a third party in the context of an equity issue, in permitting the bidder to preserve the equity status of the bid for accounting purposes. This assumed particular importance in the mid–eighties when UK bidders were looking for advantageous ways of accommodating large write–offs of accounting goodwill generated by buoyant stock prices. The empirical model tested in this paper controls for the hostility of the bid, and for taxes, but also includes two other factors not hitherto mentioned in this literature. The empirical literature on corporate new issue behaviour has shown both share prices and capital structure to be significant factors in decisions to issue equity (Marsh (1982)). Seen from the bidder's perspective the choice of consideration is an issue decision, hence it is hypothesised that cash is more likely to be issued in takeovers when bidders are liquid, or when they perceive their stock or the market as a whole to be undervalued; and bidders will issue equity to correct high financial leverage, or after strong price performance in the bidder's own stock or in the market.

The paper uses a sample of 373 of the larger mergers and acquisitions between UK quoted firms from 1976 to end–1987. The substantive findings of the paper are that bidders facing large write–offs of accounting goodwill were more likely to issue equity in a takeover; also that the use of equity as consideration in UK takeovers during the merger wave of the 1980s was also positively and significantly related to the amount of cash in the bidder's possession and to a recent history of positive abnormal returns on the bidder's own stock and of strong market performance. All of these are factors that have received little or no attention in the literature on the financing of takeovers. No evidence is found that vendor capital gains tax liabilities were relevant to the choice of consideration, or that bidders were less likely to use equity in hostile bids. Nor were other bidder variables such as bidder leverage or payout ratio significant factors.

The paper proceeds as follows: Section 2 develops the propositions and reviews the existing literature. Section 3 describes the data and the construction of the sample, while Section 4 presents the empirical analysis and results. Section 5 draws some conclusions.

2 DEVELOPMENT OF THE HYPOTHESES

2.1 Existing literature

It has been well documented that cash bids attract higher bid premia by Franks et al (1988) in their study of more than 2500 UK and US takeovers over the period 1955–1985; in US studies by Huang and Walkling (1987), Travlos (1987), Asquith, Bruner and Mullins (1986), and Wansley, Lane and Yang (1983); and in France by Eckbo and Langohr (1989). In the Asquith study target bid premia over the period 1975–1983 averaged 27.5% in cash bids, as against 13.9% in equity bids.

Clearly, in a world with symmetric information and without taxes and transaction costs the means of payment for a takeover is irrelevant, and the existing empirical literature on the financing of takeovers has focused almost exclusively on tax and information asymmetries. Capital gains taxes offer a ready explanation for higher premia in cash bids. Vendors can roll over the capital gain if they receive equity but not when they receive cash, so will require an additional premium in cash bids to compensate for the forgone tax deferment. In the UK rollover applies to the equity component whatever the mix of consideration and also applies if the consideration is bonds[1]. However until the Tax Reform Act 1986 abolished the concession[2], the US tax code offered offsetting tax gains at the corporate level since, in cash bids, bidders could 'step–up' the basis for tax depreciation where acquired assets had a fair market value above book without a corresponding capital gain to the acquired firm[3]. There is no offset of this sort in the UK, so the capital gains tax argument for equity appears particularly strong – if capital gains tax were the only market imperfection we would expect to see no cash bids. In reality

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[1]By contrast, total consideration must be more than 50% equity to qualify for 'tax–free' status in the US and this proportion is 100% in Canada(Eckbo et al(1989)).

[2]With full effect from January 1989.

[3]See Hayn(1989). Even where 'step–up' in basis was available, because of deferral, the enhanced depreciation allowances had a lower present value than the immediate capital gains liability (Auerbach and Reishus(1988), Dicker(1988)).

there may be a significant group of investors who are infra–marginal: some institutional investors such as pension funds are tax exempt in the UK, whilst individuals with total gains within the tax–free limits may even prefer cash bids as offering a lower–cost method of utilising unused tax allowances than, say, bed–and–breakfast arrangements. Empirically, the capital gains tax hypothesis has found little support. Differences between cash and equity bid premia existed well before the introduction of capital gains tax in the UK in 1966, and have been unresponsive to changes in the rate since then (Franks et al (1988)). Eckbo and Langohr (1989) found that the value of the 'option to tender' was the same in all–cash and all–equity offers and took this as evidence of the non–existence of a tax effect. Niden (1988) used variables proxying the tax position of bidder and target in a sample of US takeovers, and found no relationship between the taxpaying status of target shareholders and the form of the consideration.

Myers and Majluf (1984) showed that when the bidder has private information about the value of the bid but the target does not, cash bids will be made, since vendors will expect bidders to offer paper only when they believe it to be overvalued. In Fishman (1989) the choice of medium of exchange in a bid may serve the function of pre–empting rival bids and he describes an equilibrium with both cash and equity bids; cash has the advantage of pre–empting rival bids, while the use of equity or risky debt permits vendors to condition their accept/reject decision on the value of future cash flows[4]. Cash may also have a pre–emptive role in hostile bids simply by dint of the speed with which it can be deployed. Ruback (Ruback (1984), Jensen and Ruback (1983)) suggests that where a bid lacks the endorsement of target management, vendors will prefer consideration that is easy to value, such as cash; implying that cash will be offered in hostile bids.

Attempts to model the information structure have not so far embraced the fairly complex

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[4]Hansen(1987) develops a similar model in which bidders have in addition private information about their own pre–bid value.

reality of, for instance, the UK where vendors may be offered both mixed consideration and alternatives, and where bids are often underwritten, thus detaching the consideration offered to the vendors from that received by the bidder. Neither Fishman (1989) nor Hansen (1987) model mixed bids, and Eckbo et al (1989) do so but in the context of Canada where shareholders are not offered alternatives there is wide cross–sectional variation in the use of equity, bonds and cash to finance takeovers; mixed bids are common, and bidders commonly offer alternatives, in contrast to the US and the UK shareholders are not offered alternatives. While signalling effects are likely to depend on the structure of successive offers and the capital gains tax effects on the final offer, the financing effects on the bidder depend on the issued consideration.

2.2 Accounting effects of the choice of consideration

The accounting effects of takeovers became a major preoccupation of UK managers in the 1980s. Following the 1981 Companies Act UK bidders were able, so long as control of more than 90% of the target was achieved by the bid, to take 'Section 131 merger relief' which relieved them from setting up a share premium account for any equity that was issued in the bid. This had two effects. Statement of Standard Accounting Practice 22, issued in 1984, gave bidders the option to write the goodwill[5] in a purchase straight off against reserves in the group balance sheet, rather than follow the practice in other countries of capitalising the goodwill and amortising it through the P&L.

This treatment enhanced the reported earnings per share of UK bidders and was almost universally adopted, but as a rising stock market drove up the goodwill component of bids in the mid 1980s the book equity of many acquisitive firms became depleted and in some cases negative[6]. Figure 1 plots the annual average of the ratio of goodwill to the book net

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[5]Accounting goodwill is the difference between the market value of the consideration and the replacement cost of the tangible net assets acquired.

[6]The existence of adequate reserves did not in general pose a binding constraint on

worth of the bidder for the takeovers investigated in this paper. Whereas given the low q ratios of the 1970s and early 1980s takeovers were often transacted at around tangible asset values, by the mid–1980s bidders were typically writing–off goodwill on a single acquisition of over 40% of their pre–existing net worth. By taking 'merger relief' bidders could at least show the goodwill write–off, to the extent of any share premium arising, as a write–off against the 'capital' reserve of share premium rather than revenue reserves in the group balance sheet. In fact this effect was purely cosmetic, since the ability to make subsequent dividend distributions was a function of the parent's rather than the group's balance–sheet.

A second motive for taking merger relief was its effect on the parent firm's ability subsequently to release dividends from the subsidiary. By taking merger relief in the balance–sheet of the parent firm the legal 'cost' of the subsidiary for dividend purposes could apparently be considered to include only the nominal value of any equity issued. So the subsidiary's assets could be distributed down to this lower level and still be a 'realised profit' in the hands of the parent, rather than a return of capital. Though this interpretation of the merger relief rule gained support during the 1980s its validity remained unclear and it was not tested in the courts. In any event it is hard to believe that for many firms this option to release additional dividends from a subsidiary could be of significant value to shareholders. In the empirical work below this factor is proxied by a measure of the adequacy of the bidder's reserves to support its current dividends.

Though merger relief is a component of the particularly permissive UK goodwill accounting treatment there is an implication for other jurisdictions. In most jurisdictions it is a necessary but not usually sufficient condition that a takeover be predominantly equity financed for it to qualify for pooling, and thus to avoid amortisation of goodwill

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goodwill write–offs. Some companies applied to the courts to have existing share premium reclassified as distributable; other companies showed negative net worth.

and depletion of earnings per share. Since amortisation of goodwill is typically not a tax expense this is purely a difference in accounting treatment, and evidence from the efficient markets literature (Hong, Kaplan and Mandelker (1978)) suggests that firms do not add value by using pooling. But if avoiding this sort of earnings per share depletion is a goal of managers, they may seek to structure the takeover to qualify for pooling.

Carleton, Guilkey, Harris and Stewart (1983) investigated 61 targets in acquisitions occurring in the US during 1976 and 1977, and found that targets with higher market to book ratios, and thus higher implicit goodwill, were more likely to be acquired in an equity bid. However they did not offer an accounting explanation for this.

2.3 Market and capital structure factors

The choice of the means of payment in a takeover can have a significant impact on the capital structure of the bidder and is a financing decision from the bidder's point of view. There is some evidence that firms do attempt to maintain target borrowing levels (for instance Marsh (1982), Bosworth (1971), Taggart (1977)). Takeovers may offer a less costly opportunity to adjust capital structure than other methods and, if so, highly levered firms will tend to issue equity in a takeover, while cash–rich firms will use cash. Firms with surplus cash might fear that a stock repurchase or an increase in dividend signals a lack of internal growth opportunities. Alternatively, the 'trapped–equity theory' describes a tax advantage in some systems to distributing cash through takeovers rather than through dividends or stock repurchase (see King (1986) for a recent exposition). On the other hand, if the firm is highly levered managers may believe an equity issue in the context of an acquisition to be more socially acceptable than a rights issue. Moreover in the UK, the regulatory constraint is slacker on equity issues in the context of a takeover: firms must seek approval from shareholders for new issues above 5% of existing equity, whereas shareholders' approval is required only for acquisitions above 25% of net assets under the Stock Exchange class test rules.

There is empirical and anecdotal evidence to suggest that managers are influenced in the timing of equity issues both by the recent level of returns on the market as a whole and by the recent performance of the firm's own stock. In discussion, managers and their advisers attach much importance to these factors and after the stock market crash of October 1987 equity almost disappeared as consideration in UK mergers and acquisitions, an event that was widely interpreted in terms of unsuitable market conditions. Brealey, Hodges and Capron(1976) and Marsh(1982) in the UK, and Taggart (1977) in the US, report that equity issues tended to follow market rises, while Marsh(1979) and Marsh(1982) in the UK and Scholes(1972) and Smith(1977) in the US found that the

residual return on the firm's stock was significant in the timing of equity issues.

3 DATA, SAMPLE AND EMPIRICAL MODEL

This section describes the sample and the construction of the independent and dependent variables.

3.1 Sources of data and structure of the sample

Accounting and share price data are available for UK firms on the Exstat accounting data tape and the London Share Price Data (LSPD) tape. LSPD records stock market data for all UK quoted firms since 1975, and about two thirds of quoted firms from 1948 to 1975. Exstat collects published accounts data, starting in 1970 on a population consisting of quoted UK firms and other members of the Times 1000. The Exstat coverage was expanded in 1975/76 to include smaller quoted firms. Data on the goodwill in the combination and the means of payment issued are not available on Exstat, and necessitated the search of company reports. The revision of the bidder's prior year accounts figures which takes place when pooling is used is also recorded by Exstat and would generate observation bias, so for bidders in pooled takeovers prior year annual accounting data were collected from company reports to replace data from tape. Data on the payment offered to vendors were collected from the Stock Exchange Yearbook and the Financial Times Mergers and Acquisitions, which record last offer data. First bid dates were collected from Extel cards.

The sample contains all bids with the following attributes: 1. The bid took place between April 1976 and October 1987. 2. Both bidder and target were quoted on the London Stock Exchange at the time of the bid. 3. Two year's history pre–bid existed on Exstat for bidder and target, and one year post–bid for the bidder. 4. One year's share price history was available for bidder and target pre–bid. 5. The bid was successful, and

achieved control.

The choice of 1976 as the start date has advantages in terms of topicality and from a data collection perspective, since both the Exstat and LSPD populations were broadened around 1976, and hardcopy and microfiche records of firm accounts are more problematic before that time. The last takeover in the sample was in October 1987[7]. The requirement that both parties be recorded on Exstat and LSPD restricted the sample to combinations between UK quoted firms. Some combinations involving relatively small firms, including USM stocks, are included, but sales of subsidiaries and combinations involving overseas firms, both significant in this period, are excluded. Exstat predominantly covers the industrial and commercial population so combinations involving financials are excluded. The sample is restricted to successful takeovers, in common with most existing literature in this area. Though in some contexts the exclusion of failed bids requires careful interpretation, in the current paper, where the emphasis is on choice of consideration within a cohort of takeovers, it would not appear to be troublesome. 620 firms on Exstat since 1976 are recorded as subsequently being taken over by UK firms and of these, 373 met the selection criteria.

The selection method provides a research sample with known economic and financial attributes, which contains a significant proportion of major takeovers between UK quoted industrial and commercial firms since 1976. Table 2 presents shows the number of takeovers in the sample each year, and the size distribution within each year, in terms of the value of the consideration paid for the target[8]; as the size distribution is skewed (to the left) Table 2 also shows mean and median values. The takeovers in the sample range

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[7]This was the last date for which data were available, and coincides with the stock–market crash purely by coincidence!

[8]In most takeovers there was no difficulty in identifying the target and the bidder. But where this was not clear, the continuity of the chairman and board of directors was used as the criterion for dominance.

from some very small targets with values of less than 0.5m pounds to bids worth many hundreds of millions of pounds. The average takeover in the sample is rather larger than in the population as a whole, since the sample is restricted to quoted firms.

3.2 The empirical model

In the model to be tested the consideration used in takeovers is a function of the following factors: i. the accounting impact of the bid, ii. the prior financial structure of the bidder, iii. recent returns on the bidder's stock and on the market, iv. whether the bid was friendly or hostile, v. the capital gains tax implications for vendors. The bidder's ability to accommodate the write–off of accounting goodwill depends on the size of the goodwill relative to its existing net worth, hence the accounting impact was proxied by the ratio of the estimated goodwill in the target to the bidder's book net worth in its last balance sheet. Goodwill was measured as the excess of the value of the final bid over the fair value of the target's net assets or, where the fair value was not disclosed by the bidder, their book value[9]. A second strand of the accounting hypothesis is that bidders would value the enhanced option to distribute the target's assets which is provided when equity is used and merger relief is taken. To test this, it was hypothesised that bidders would value this option more highly the greater the ratio of the bidder's current dividend to its distributable reserves.

The financial structure hypotheses were tested using measures of liquidity, leverage, and size. Financial leverage was measured as the ratio of the bidder's net borrowing defined as short plus long–term borrowing less cash and marketable securities to its net borrowing plus equity, all at book values[10]. Hence the leverage variable was the deviation

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[9]Since many bidders make multiple acquisitions in a year, data were also collected on total goodwill purchased in the year. However the availability of these data was patchy and the introduction of an extra variable, total goodwill to bidder net worth, contributeed no additional explanatory power so was not pursued in the analysis reported below.

[10]The use of book rather than market leverage accords more closely to the measures used

of the bidder's current leverage from its target, where the target was proxied by the arithmetic mean leverage over the previous ten years, or shorter period for which data was available. Measured net of cash, leverage embraces both the level of borrowing and the amount of cash in the bidder. In addition a liquidity variable was included separately in the model, measured as the ratio of the bidder's cash plus marketable securities to its total assets. There is a potential problem empirically, since there is some risk that liquidity measures will be distorted by a prior financing in anticipation of the takeover. To control for this, albeit imperfectly, a measure of the flow rather than stock of cash was also included; operating profits gross of depreciation plus extraordinaries to total assets. The assumption here is that high liquidity in the presence of average cash flow may signal a prior financing issue. Finally, it was hypothesised that the impact of the takeover on the bidder's capital structure was likely to depend on the size of the target, both absolutely and relative to the bidder. The influence of size was proxied by the ratio of market capitalisations of target and bidder and by the (log) market capitalisation of the target, all measured six months pre–bid to reduce bias induced by differential bid premia in cash and equity bids.

Residual returns on the bidder's stock were calculated for each of the three quarters preceding the bid. LSPD returns are calculated from the average of market makers' bid and ask prices at each month end, and the residual return on the bidders' shares was measured assuming a unit beta, as the excess of the bidder's continuously compounded return over the return on the FT Actuaries index. To assess the influence of conditions in the equity market as a whole, it was conjectured that the bidder's decision to issue equity was a function of two environmental factors: the recent level of new equity issues for mergers and acquisitions, and recent returns on the market index. To capture the

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by managers, and relates to the value of assets in place rather than future growth opportunities (Myers(1977)). Previous work suggests that the use of market instead of book leverage would not significantly alter the results (Marsh(1982)).

joint influence of these factors, a simple forecasting model was fitted to quarterly data from 1971 (the earliest available) to 1987 for new equity issues [N_t] in billions of dollars at 1988 prices using CSO Financial Statistics data, and for continuously compounded returns on the FT Actuaries index [M_t][11], as follows (t–statistics are in brackets).

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[11]A similar approach was adopted by Marsh(1982) in his study of new issues of equity and debt.

$$(1) \qquad N_t = \underset{(0.23)}{.1299} + \underset{(8.91)}{.747N_{t-1}} + \underset{(1.49)}{.7929M_{t-1}} + U_t, \quad R2 = .58$$

Empirically, no lags of N and M beyond the first proved significant, thus it was assumed that firms would assess market conditions in period t from historic data as the forecast Nt from equation (1).

Bids were classified as 'friendly' or 'hostile', where to be friendly it was necessary and sufficient that the first bid was accepted. Obviously any attempt to generate an index of hostility using secondary data is open to criticism. For instance the 'first–bid' criterion treats as hostile courtship rituals where the victim is merely holding out for a better price from a satisfactory suitor, while a white knight is always classed friendly[12]. Table 3 reports that around 20% of bids in the sample were hostile on this criterion. Whereas during 1979–1982, a period of recession in the UK, 26% of the takeovers in the sample were hostile, over the period of relative profitability and market growth from 1984–1987 only 15% were hostile.

In a rising market, the goodwill element in acquisitions also rises, other things equal. The same conditions also generate capital gains. Hence evidence in support of the accounting or misvaluation hypotheses could also be construed as supporting the capital gains tax hypothesis. Carleton et al (1983) found an association between the target's market to book ratio and the use of equity, and argued a tax explanation[13]. To test these hypotheses separately a proxy was calculated for the accrued capital gain on the target equity. The magnitude of the capital gains tax liability is a function of investor's tax rates and of their accrued capital gains. Cross–sectional data are not available on investors' marginal

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[12]In fact white knights were involved in only 15 out of the 373 cases.

[13]They appeared to be implicitly assuming that the vendor's tax basis in the stock could be associated with the book value of its equity.

tax rates or holding periods for shares, however we do have data on the target's share price movement during the period pre–bid. So it was assumed that the vendors' accrued gains are positively related to the change in the target's share price in the two–year period pre–bid. In order to avoid bias caused by differential residual returns to targets in cash and equity bids, this variable was measured over the period from 24 months to 6 months pre–bid.

Table 5 shows the correlations between model variables. Only one of the three residual return lags is shown, as representative. Unsurprisingly the relative size and the target goodwill to bidder net worth variables are highly correlated (.67). The implications of this for empirical testing are discussed in Section 4.

3.3 Construction of the dependent variable

Data on the value of equity, cash and debt issued in the takeover were collected from the bidder's next published accounts following the bid. In a very few cases the bidder had not disclosed this split for individual acquisition but for takeovers in total, so these proportions were used. Bids were then classified 'equity' where over 50% of the consideration was equity and 'cash' where over 50% was cash. Because they involved a significant amount of debt, 15 bids fell in neither category and were excluded from the subsequent analysis. There are 215 equity and 143 cash bids in the sample; year on year the number of cash and equity bids is approximately equal until 1983; in 1983 and from 1985 to 1987 equity outnumbers cash by four to one. 139 of the equity bids were all–equity, 89 of the cash were all–cash, where 'all' means at least 90% was of this form[14], so the data are strongly bimodal. The data were classified, rather than kept as continuous, for two reasons. First, the consideration data are bounded and are strongly

[14]The cutoff of 90% was chosen to reduce the risk of misclassification. an unsystematic survey of the sample suggests that approximately 6% of the value of UK acquisitions is consumed by costs including transaction costs and underwriting; these costs are likely to be 'cash' and some bidders do not disclose these seperately from the consideration.

bimodal. The boundedness, in particular, breaches the assumptions of OLS. Second, the elements of the empirical model tested in this paper essentially relate to a model of the binary choice: cash or equity. For both these reasons a categorical methodology is suggested.

Though cash forms a higher proportion of total expenditure on average in the aggregate UK data reported in Table 1 than in the sample, partly because their data include sales of subsidiaries, the shift to equity in 1983 and 1985 to 1987 exactly mirrors that in the sample. For each combination in the sample, data were also collected on payment offered to vendors in the final bid. Prime sources of their data were the Stock Exchange Yearbook and the Financial Times Mergers and Acquisitions book. Where cash was offered but no cash was recorded as being issued, this was taken as evidence of a cash alternative provided by a third party. 52 of the 139 equity bids had a cash alternative on this basis. Some cases of the reverse were found; vendors were offered cash or equity but the firm only issued cash, suggesting some infeasible form of intermediation. In checking these cases with the firms concerned, what had happened is that an offer giving a choice of equity or cash had been stranded by a subsequent fall in share price, leading all vendors to take cash.

4 EMPIRICAL RESULTS

This section describes the results of testing the model of the choice of means of payment using logistic regression. Before doing so, a preliminary description of the sample on a univariate basis is provided.

4.1 Univariate differences

Table 4 compares the model variables on a univariate basis, using the difference in medians[15] between the cash and equity groups as a non–parametric test of significance. Targets in equity bids were larger both absolutely and relative to the bidder than in cash bids and, consistent with the accounting hypothesis, goodwill formed a higher proportion of bidder's book net worth in equity than in cash bids. Though the relative size and goodwill variables are both significant discriminators at the 1% level, they are also highly correlated (Table 5). Equity was more likely to be issued in a favourable market, as measured by the market conditions variable, also significant at the 1% level. The leverage variable is constructed to have a lower value the lower the bidder's current leverage relative to its historic average; on this measure there was a significant (at 5%) tendency for 'undergeared' bidders to use cash. All the other model variables (liquidity and cashflow, residual returns, capital gains) had the predicted sign, but none were significant. There was no significant difference in the degree of hostility between equity and cash bids.

However, it is clear that the differences for the whole period do not apply to sub–periods and the model was reestimated for the period 1976–1982 and 1983–1987[16]. In terms of the accounting hypothesis an earlier split might seem called for, at 1981, when the Companies

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[15]Beside the medians test SAS/STAT also reports Wilcoxon, Van der Waerden, and Savage scores appropriate to other assumptions on the underlying distribution. The discrimination reported here was not significantly affected by the distribution assumption.

[16]While the mid 1980's was a period of rapidly risind stock prices, growing output and of merger boom, 1978 to 1982 was a period of recession.

Act introduced Merger Relief. However attempts to align accounting data with legislative changes can be rather false: restrictive rule changes are sometimes anticipated by some firms, while permissive rule changes may not be implemented immediately. Merger Relief was a permissive change; and it is universally claimed by practitioners that the possibilities it offered were not appreciated for at least two years. Higson(1990)[17] found little evidence of the use of Merger Relief in the first two years of its existence. Hence, again, 1983 was suggested as a suitable date to partition the data.

Some experimentation with partitions suggested that the results were not greatly affected by moving the partition a year in either direction. Results are reported for the two sub–periods in Table 6. There are 159 observations in 1976–1982, and 197 from 1983 on. Most of the discrimination reported for the whole period is coming from the second period, of merger boom. The most significant feature distinguishing equity and cash bids in the period to 1982 is that targets were bigger, both absolutely and relative to the bidder, in equity bids. There was also a mildly significant (at 10%) difference in the goodwill and relative value variables, and in the degree of hostility between the groups.

In case the simple equity/cash classification being used here is masking interesting non–linearities the univariate comparison was also run for the whole period and sub–periods comparing the group at each tail, all–equity and all–cash, as defined earlier. The results were unchanged with one exception: (liquidity becomes significant at 5% in discriminating between the all–cash and all–equity groups, overall and in the earlier period, and significant at the 10% level in the second period.

4.2 Multivariate analysis of equity versus cash choice

A logistic regression was estimated for the binary choice, equity versus cash, for the whole

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[17]'The Choice of Accounting Method in UK Mergers and Acquisitions', ICAEW, 1990

period 1976– 1987 and for the two subperiods 1976–1982 and 1983–1987. The first panel of Table 6a shows the logit results. Because the accounting goodwill and relative size variables are highly correlated, the model was estimated, initially, excluding relative size. for the period 1983–1987. Four variables – liquid assets, goodwill, market conditions and 2–period residual return on the firm's shares were significant (at 10% or better) in the choice of equity versus cash and all had the hypothesised sign. One period residual return was also significant but had a 'perverse' negative sign suggesting an inverse relationship between the choice of equity and the bidder's abnormal return in the period immediately pre–bid. The equation is significant overall, and the single most significant variable is goodwill: bidders were more likely to make an equity bid when the bid contained a larger component of accounting goodwill. A general rise in stock prices generates higher accounting goodwill and capital gains tax liabilities. This raises the possibility that a positive coefficient on goodwill is proxying for a tax or market conditions effect, and Carleton et al (1983) reported a similar result, but attributed a tax explanation. An independent proxy for the vendor's capital gains liability was included in the regression; the proxy for capital gains is not significant, rebutting the proposition that goodwill is simply a surrogate for accrued capital gains liabilities.

The goodwill variable, measured as goodwill to bidder net worth, and relative size, measured as target to bidder market capitalisation, are highly correlated, raising the possibility that goodwill is simply proxying a tendency to use equity in relatively large acquisitions. Whereas the first panel of 6a was estimated excluding relative size, the second panel shows a regression in which goodwill is replaced by the relative size. The equation is still significant overall, though less so, and the relative size is itself non–significant. This suggests that size was proxying goodwill rather than the reverse. But it is noteworthy that in the absence of goodwill the market conditions variable becomes more significant, reflecting the comovement between these variables. Bidders

were more likely to make an equity bid when they had a relatively low level of liquid to total assets. However the other capital structure variable, leverage, was not significant. One source of corporation liquidity is cash flow, but the current cash flow measure was not significant in the regression, nor were two and three year average cash flow measures – there was no evidence that firms with high cash flow were more likely to use cash in bids. It is possible that bidders become liquid by other means, for instance through the proceeds of a disposal, but in interpreting the liquidity result we cannot rule out the possibility that, rather than a liquidity effect, we are merely observing the effects of an anticipatory financing by bidders planning to use cash.

The 'misvaluation' variables were significant, and bidders were more likely to use equity after strong market performance in general. But the significant residual return with positive sign was the second lag, between 6 and 3 months pre–bid. The first quarter return had a perverse, negative sign and the third quarter lag had no explanatory power in any of the models. This contrasts with Franks et al (1988) results on US bids, but may be consistent with their UK results. They found that US bidders offering equity had bid premia of 2.4% in the period between 6 and 1 month pre–bid, while cash bidders showed –0.6%, in the UK their figures were 3.4% and 5.0% respectively.

The above conclusions do not apply to the period 1976–1982, where logistic regression could not produce a statistically significant model of the cash/equity choice as is shown in the second panel of Table 6. In this model only liquidity emerges as significant, with consistent sign. The goodwill variable has a consistent but smaller coefficient, and is not significant. This is consistent with our conjecture that goodwill only became relevant to the choice of consideration after the accounting rule changes of the early 1980's. However, the failure of the earlier period to generate a significant model is intriguing and merits further research.

The third panel of Table 6a reports an equation for the whole period, but because of the influence of the earlier sub–period, this equation is also not statistically significant.

Table 6b fits the model to the tails of the distribution for the period 1983–1987, by comparing all–equity and all–cash bids. Because the categories were more clearly discrete, the explanatory power of the model was enhanced; the coefficients were consistent in sign, and similar in level. However only goodwill, liquidity, and the two period residual return are individually significant.

5 CONCLUSIONS

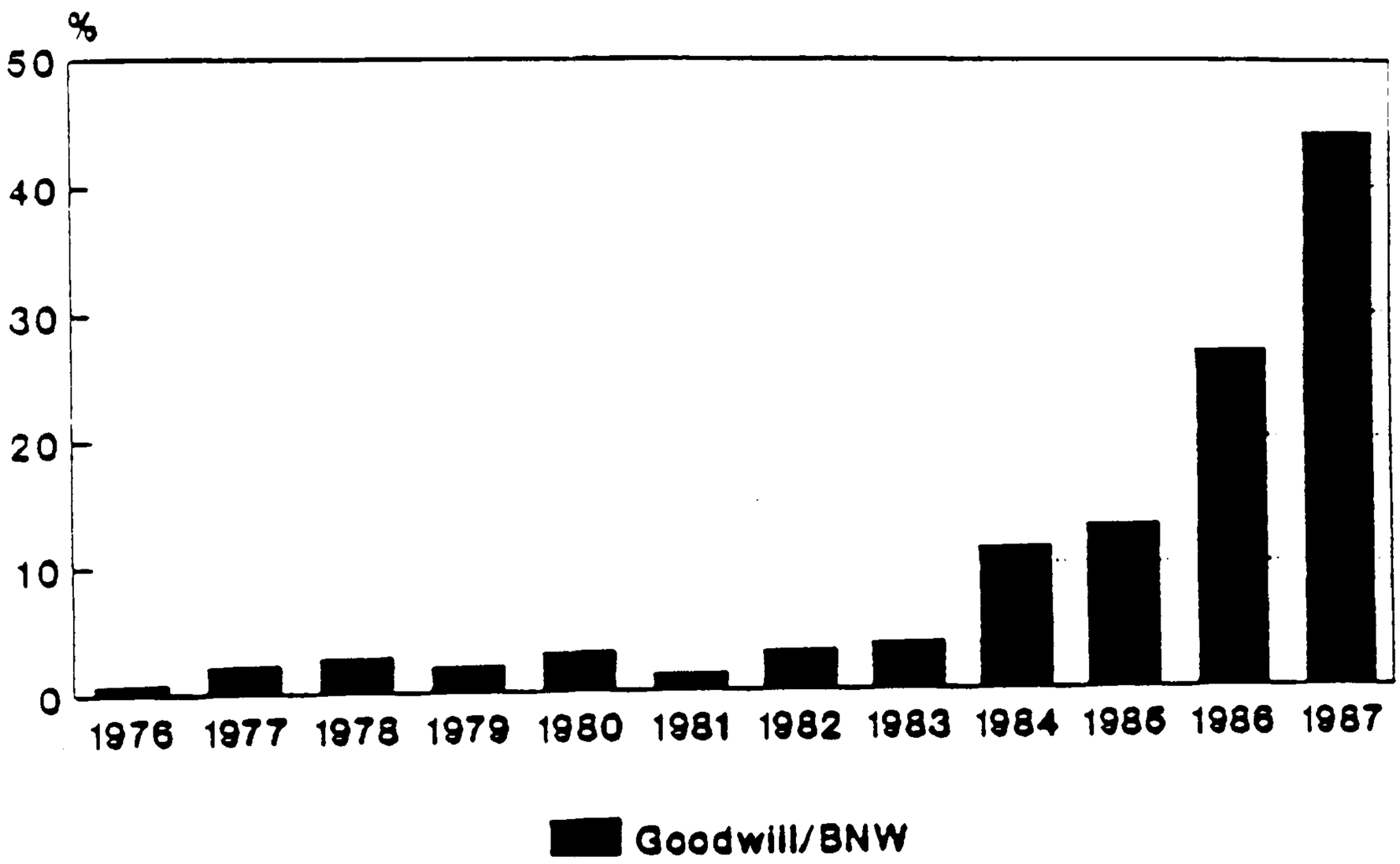
Though a good deal of research effort has gone into establishing the link between bid premia and the consideration offered to vendors, little empirical evidence has been available on the factors which drive the bidder's choice of means of payment. Since intermediation can, at least partially, separate issued and offered a different explanatory model may be appropriate. Alongside the tax and signalling models which have predominated in existing work, we hypothesise that those factors which have been found significant in the new issue literature, returns on the market and on own stock and capital structure factors, would also influence the choice of consideration in a takeover. In addition the paper considers the effect of accounting regulations on the structuring of mergers and acquisitions and proposes a new role for the cash alternative underwritten by a third party, in preserving the equity status of a bid for regulatory purposes. The empirical findings of this paper support the hypothesis that accounting regulations, equity market conditions and the bidder's recent share price performance influenced the choice of means of payment in UK takeovers in the period 1983–1987. While bidder liquidity was also a significant factor, no role was found for other bidder attributes such as leverage or for target payout. The liquidity result needs to be treated with caution, since bidders using cash tended to have more cash available but not to have stronger cash flow,

suggesting that we may be observing the results of anticipatory cash raising. The scale of accrued capital gains and of accounting goodwill are both likely to be positively related to conditions in the equity market. In a joint test, goodwill and the level of the market were both significant, but no evidence was found that accrued capital gains tax liabilities influenced the choice of consideration.

It was not possible to construct a statistically significant explanatory model for the earlier period, 1976– 1982, suggesting that while marked differences exist between cash and equity bids in merger waves, they do not exist at other more normal times. More research is needed on this intriguing finding.

FIGURE 1 THE GROWTH OF ACCOUNTING GOODWILL

This figure plots the annual, equally–weighted arithmetic mean of the ratio of the accounting goodwill in each bid in the sample to the book net worth of the bidder at its previous accounting year end. The bottom and top quartile are excluded. During the 1970s and early 1980s relatively low market to book ratios for firms meant that, even after a bid premium firms were regularly transacted below book. In the–mid eighties this ceased to be the case; goodwill became significant, particularly relative to the dwindling book net worth of multiply acquisitive bidders.



ratio of goodwill to bidder net worth
(equally weighted annual average of interquartile observations)

TABLE 1 AGGREGATE DATA ON THE CONSIDERATION USED IN MERGERS AND ACQUISITIONS BETWEEN UK INDUSTRIAL AND COMMERCIAL FIRMS, 1973–1988

Percentage of total annual expenditure on takeovers which was cash, equity or fixed interest.

	No. of takeovers	Value* (£m)	Cash %	Equity %	Fixed Interest %
1973	951	4753	53.0	35.7	11.3
1974	367	1761	68.3	22.4	9.3
1975	200	672	59.4	32.0	8.6
1976	242	937	71.7	26.8	1.5
1977	372	1672	62.1	36.9	1.0
1978	441	2076	57.4	40.6	2.0
1979	417	2700	56.3	31.1	12.6
1980	368	1987	51.5	45.5	3.1
1981	327	1250	67.7	29.6	2.7
1982	299	1827	58.1	31.8	10.1
1983	305	2386	43.8	53.8	2.4
1984	398	5215	53.8	33.6	12.6
1985	340	7054	40.3	52.3	7.4
1986	537	13319	25.6	57.9	16.5
1987	905	11818	32.2	62.3	5.5
1988	937	16870	69.7	21.9	8.4

Source: UK Central Statistical Office Business Trends (Aug 1989)
* At 1988 prices

TABLE 2 SIZE DISTRIBUTION OF THE SAMPLE

The distribution of the sample in terms of mean, median, maximum and minimum values, using the last bid price in $m. The sample is, like the population, skewed towards smaller bids.

Year	Mean	Median	Min	Max	No. in Sample
1976	3.7	2.0	0.3	17.8	14
1977	7.8	4.5	0.2	25.1	37
1978	9.9	6.2	0.8	54.9	30
1979	22.8	13.1	1.3	151.2	20
1980	19.5	6.0	0.5	107.0	22
1981	10.0	5.0	1.2	60.0	23
1982	50.2	10.8	0.3	258.2	22
1983	26.5	7.5	2.5	236.7	21
1984	44.4	10.6	0.6	607.0	49
1985	45.1	19.6	0.7	2695.0	55
1986	48.8	14.5	1.8	789.5	56
1987	43.7	17.1	1.5	328.0	24
					373

TABLE 3 ATTRIBUTES OF THE SAMPLE

In the panel headed 'consideration' sample are classified as equity or cash where more than 50% of the consideration was of that form, and 'other' where, usually because of significant use of debt as consideration, neither is the case. In the panel 'tails' all equity or all cash implies at least 90% of the consideration was in that form. Sample are identified as having a cash alternative when bids recorded as 100% equity by the bidders showed evidence of a cash alternative in offer data.

		Consideration			Tails		Hostility	
Year	No in sample	Equity	Cash	Other	All equity	Cash alternative	All cash	No.	% of Sample
1976	14	6	8	0	3	0	4	3	21%
1977	37	15	21	1	8	1	13	5	13%
1978	30	14	15	1	8	4	8	3	10%
1979	20	11	9	0	7	2	4	5	25%
1980	22	10	10	2	6	3	6	7	32%
1981	23	11	11	1	7	4	8	6	26%
1982	22	8	12	2	4	0	7	5	23%
1983	21	13	7	1	8	1	4	5	24%
1984	49	22	23	4	14	4	16	10	20%
1985	55	43	11	1	22	9	8	12	22%
1986	56	43	11	2	34	18	8	6	11%
1987	24	19	5	0	18	6	3	0	0%
	373	215	143	15	139	52	89	67	

TABLE 4 UNIVARIATE DISCRIMINATORS

Table shows the median value of each variable over the two periods and over the whole period. Chi2 are for a difference of medians test, using the convention: significant at 1%, ***; 5%,**, 10%,*. All accounting magnitudes relate to the last annual accounts of target or bidder pre–bid.

		1976 - 1982			1983 - 1987			1976 - 1987		
		Equity	Cash	Chi^2	Equity	Cash	Chi^2	Equity	Cash	Chi^2
1.	Goodwill/BNW	.020	.010	2.84*	0.280	0.020	35.36***	0.160	.100	38.82***
2.	Leverage	.041	-.032	1.58	-.057	-.197	5.22**	-.017	-.084	4.19**
3.	Liquidity	.034	.045	1.24	.055	.080	2.93	.048	.060	1.40
3a.	Liquidity (all-equity versus all-cash)	.029	.0458	5.06**	.045	.076	2.48*	.036	.056	5.38**
4.	Target value	2.140	1.482	7.51***	2.815	2.230	6.37**	2.58	1.189	11.16***
5.	Relative value	.214	.092	4.62*	.217	.072	15.59***	.215	.062	17.66***
6.	Market conditions	.327	.326	0.44	.886	.626	4.87**	.587	.373	19.91***
7.1	Residual Return - 1	-.002	-.001	.05	.012	.038	1.90	.006	.004	.06
.2	- 2	.030	.033	.14	.035	-.005	.91	.034	.017	.09
.3	- 3	.001	.028	1.99	.020	.010	4.78**	.070	.015	.13
8.	Hostility			3.55*			.03			2.61
9.	Target Capital Gain	.374	.453	.27	.407	.271	1.65	.407	.357	.29
10.	Dividend/Reserves	.057	.056	0.66	.061	.056	1.65	.057	.057	.44
11.	Cash flow	.149	.149	0.05	.139	.141	0.14	.014	.143	.00

Variable definitions:

1. Goodwill/BNW = goodwill in the target to the bidder's book net worth.
2. Leverage = deviation of bidder's leverage from its target, where leverage is long-and short-term borrowing to borrowing plus equity, all at book.
3. Liquidity = bidder's cash and marketable securities to total assets, equally weighted average for the last two years.
4. Target value = market capitalisation of target equity six months pre-bid.
5. Relative value = target to bidder market cap (as above).
6. Market conditions = forecast new equity issues for mergers and acquisitions (£1988bn) in this quarter.
7. Residual return = return to bidder less return to the market over each of the three quarters prior to the bid.[-1,-2,-3]
8. Hostility = 0 if the first bid was accepted, 1 otherwise.
9. Target capital gain = continuously compounded growth in target's equity over period 24 months to 6 months pre-bid.
10. Dividend/Reserves = bidder dividend to revenue reserves.
11. Cash flow = bidder's ebit plus depreciation less extraordinaries, to sales.

TABLE 5 CORRELATIONS BETWEEN VARIABLES IN THE PERIOD 1983–1987

Correlations are shown for the 1983–1987 sub period which generated a significant model in testing. Correlations for the earlier period are similar but weaker. Variables are as defined in Table 4. For compactness only the 2–period lag residual return is disclosed, which was the most significant in testing. The very high correlation between relative size, using market capitalisations, and (target) goodwill to bidder net worth, is controlled in empirical testing.

Goodwill/ BNW									
.12	Leverage								
.32	-.06	Liquidity							
.12	.03	.05	Target Value						
.67	.01	.35	.07	Relative Value					
.06	-.21	-.13	.09	.03	Market Conditions				
.11	.02	.07	-.01	.20	.19	Residual Return -2			
.08	.04	.02	.12	.14	-.13	.06	Hostility (0/1)		
.12	.07	-.02	.24	.12	.15	.06	0.0	Target Capital Gain	

TABLE 6 MAXIMUM LIKELIHOOD ESTIMATES

Two models are shown for the period 1983–1987. The equation using goodwill dominates that using relative size. Both models are overall significant and chi2 are shown for individually significant variables. Though an equation is shown for the whole period 1976–1987, it is non–significant. Restricting the sample to the tails and using the goodwill specification in panel 6b improves the fit further.

6a PROBABILITY OF AN EQUITY ACQUISITION

	1983–1987 (using goodwill)			1983–1987 (using relative size)			1976–1982			whole period		
			chi2			chi2			chi2			chi2
intercept	0.102	(0.501)		−0.078	(0.476)		−0.750	(0.612)		−0.486	(0.260)	3.480
goodwill	1.053	(0.398)	7.00				0.546	(0.483)		0.560	(0.228)	6.06
leverage	0.136	(0.153)		0.091	(0.107)		0.067	(0.062)		0.077	(0.065)	
liquidity	−4.459	(2.288)	3.80	−3.458	(2.060)	2.79	−6.811	(3.708)	3.37	−3.681	(1.575)	5.46
target size	0.138	(0.129)		0.198	(0.123)		1.070	(1.790)		0.237	(0.087)	7.41
realtive size				0.451	(0.332)							
market conditions	0.479	(0.295)	2.64	0.652	(0.288)	5.13	−1.501	(1.120)	2.64	0.107	(0.242)	8.53
residual return −1	−2.257	(1.292)	3.05	−1.753	(1.204)	3.05				0.362	(0.845)	
residual return −2	2.650	(1.374)	3.72	2.282	(1.277)	3.19	1.001	(1.102)		1.328	(0.875)	
number	197			197			171			358		
likelihood ratio	198.8			211.1			237.7			422.6		

6b PROBABILITY OF ALL EQUITY VERSUS ALL CASH

	1983-1987		
intercept	.165	(.618)	
goodwill	.942	(.390)	5.84
leverage	.074	(.125)	
liquidity	-7.873	(3.368)	5.46
target size	.225	(.169)	
market conditions	.360	(.337)	
residual return -1	-1.136	(1.516)	
residual return -2	3.122	(1.695)	3.39
Number	136		
Likelihood ratio	131.24		

BIBLIOGRAPHY AND REFERENCES

Albrecht, W.S., Lookabill, L.L., McKeown, J.C., " The Time Series Properties of Annual Earnings", Journal of Accounting Research, Aut, 1977

Akerlof, G.A., "The Market for Lemons: Qualitative Uncertainty and the Market Mechanisms", Quarterly Journal of Economics 84, 1970, pp488–500,

Ang, J.S., "The Intertemporal Behaviour of Corporate Debt Policy", Journal of Financial and Quantitative Analysis, November 1976

Asquith, P.R., Bruner, F., and Mullins, D.W.Jr., "The Gains to Bidding Firms From Merger", Journal of Financial Economics II, 1986

Auerbach, A.J., "Corporate Takeovers: Causes and Consequences", Chicago and London, Chicago University Press, 1988

Auerbach, A.J., Jorgenson, D.W., "Inflation–Proof Depreciation of Assets", Harvard Business Review 58, 1980, pp113–18

Auerbach, A.J., "Wealth maximisation and the cost of capital' Quarterly Journal of Economics, 93, pp443–446, 1979

Auerbach, A.J., "A note on the efficient design of investment incentives", Economic Journal, 1981, 91, pp217–23

Auerbach, A.J., "Corporate Taxation in the United States", Brookings Papers on Economic Activity, 2, 1983, pp451–505

Auerbach, A.J., "Taxation, corporate financial policy, and the cost of capital' Journal of Economic Literature, 1983, 21, pp905–940

Auerbach, A.J., "Taxes, firm financial policy and the cost of capital: an empirical analysis", Journal of Public Economics, 1984, 23, pp27–57

Auerbach, A.J., "The dynamic effects of tax law assymetries' Review of Economic Studies, 53, pp205–255, 1986

Auerbach, A.J., King, M., "Taxation, Portfolio Choice and Debt–equity Ratios; A general Equilibrium", Quarterly Journal of Economics, 98, November 1983, pp587–609

Auerbach, A.J., Poterba, J.M., "Tax loss carry forwards and corporate tax incentives", NBER Working Paper No. 1863, 1986

Auerbach, A.J., and Reishus, D., "The Effect of Taxation on the Merger Decision", in Auerbach, 1988

Baron, D.P., "Firm Valuation, Corporate Taxes and Default Risk", Journal of Finance, 30, December 1975, pp1251–64

Baron, D.P., "Investment Policy, Optimality, and the Mean–variance Model", mimeo 1971

Barron, M., "The Problem of Year–End Heterogeneity in the Calculation of Industry and Economy Averages of Accounting Numbers", LBS Institute of Finance and Accounting Working Paper, Nov 1985.

Baskin, J., "An Empirical Investigation of the Pecking Order Hypothesis", Financial Management, Vol 18, no.1, Spring 1989, pp26–35

Baxter, N.D., Cragg, J.G., "Corporate Choice among Long–Term Financing Instruments", Review of Economics and Statistics 52, August 1970, pp225–35

Black, F., "Tax and Capital Market Equilibrium", Unpublished Paper, MIT, mimeo 1971

Black, F., "Taxes and Capital Market Equilibrium under Uncertainty", Sloan School of Management, MIT, mimeo, 1973

Black, F., "The Tax Consequence of Long–run Pension Policy", Financial Analysts Journal, XXXVI, July/Aug 1980, pp21–28

Bodenhammer, L., "The Effect of the Size of Public Offerings of Common Stocks upon Pre–Offering Stock Prices", Unpublished Ph.D dissertation, Harvard Business School, 1968

Bosworth, B., "Patterns of Corporate External Financing", Brookings Papers on Economic Activity 2, 1971, pp253–79

Bradley, M., Jarrell, G., and Kim, E.H., "On the Existence of an Optimal Capital Structure: Theory and Evidence", Journal of Finance 39, July 1984, pp857–78

Brealey, R., Hodges, S.D., Capron, D., "The Return on Alternative Sources of Finance", Review of Economics and Statistics 58, November 1976, pp469–77

Brealey, R., Young, C., "Debt, Taxes and Leasing", Journal of Finance, December 1980

Brealey, R., "Notes on UK Risk Premium 1919–1989", LBS mimeo, 1991

Brennan, M.J., "Taxes, Market Valuation and Corporate Financial Policy", National Tax Journal, XXV, December 1980, pp417–27

Brennan, M., Schwartz, E., "Corporate Income Taxes, Valuation and the Problem of Optimal Capital Structure", Journal of Business, 1978

Butterworths, "Yellow Tax Handbook", 1983

Carleton, W., Guilkey, D., Harris, R., and Stewart, J., "An Empirical Analysis of the Role of Medium of Exchange in Mergers", Journal of Finance 38, 1983, pp813–26

Castanias, R., "Bankruptcy Risk and Optimal Capital Structure", Journal of Finance, December 1983

Chen, A., Kim, H., "Theories of Corporate Debt Policy: A Synthesis", Journal of Finance, 34, May 1979, pp371–84

Chaplinsky, S., Niehaus, G., "The Determinants of Inside Ownership and Leverage", 1990, Working Paper, University of Michigan

Chowdhury, G., Miles, D., "Modelling companies debt and dividend decisions with company accounts data", Bank of England discussion paper, 1988

Ciccolo, J.H.Jr., and Baum, C.F., "Changes in the Balance Sheet of the US Manufacturing Sector, 1926–1977", In B.M. Friedman (ed) Corporate Capital Structures in the United States, Chicago, The University of Chicago Press, 1985

Cooper, I., Franks, J.R., "The Interaction of Investment and Financing Decisions when the Firm has Unused Tax Credits", Journal of Finance, May 1983

Corcoran, P.J., "Inflation, Taxes, and Corporate Investment Incentives", Federal Reserve Bank of New York Quarterly Review, Autumn 1977, pp1–10

Cordes, J.J., Sheffrin, S.M., "Taxation and the Sectoral Allocation of Capital in the US", National Tax Journal, 34, 1981, pp419–32

Cordes, J.J., Sheffrin, S.M., "Estimating the Tax Advantage of Corporate Debt", Journal of Finance, 38, 1983, pp95–105

Corporation Tax, 1982 Green Paper, Cmnd 8456, January, H.M. Stationary Office

Crawford, P., Harper, C., McConnell, J., "Further Evidence on the Terms of Financial Leases", Financial Management, 10, No.4, Autumn 1981, pp7–14

De Angelo, H., Masulis, R., "Optimal Capital Structure under Corporate and Personal Taxation", Journal of Financial Economics, March 1980a, pp3–30

De Angelo, H., Masulis, R., "Leverage and Dividend Irrelevancy under Corporate and Personal Taxation", Journal of Finance, 35, May 1980b, pp453–64

Devereux, M., Mayer, C., "Corporation Tax: The 1984 Budget", Institute for Fiscal Studies, Report No. 11, 1984

Devereux, M., Morris, C.N., "Microeconomic Data for Economic Research", Mimeo 1986

Devereux, M., "The IFS Model of the UK Corporation Tax", Institute for Fiscal Studies, Working Paper No 84, May 1986

Devereux, M., "On The Growth Of Corporation Tax Revenues", Fiscal Studies, May 1987a

Devereux, M., "Taxation and the cost of Capital: the UK Experience", Oxford Review of Economic Policy, Winter 1987b

Dicker, A., "Taxation of UK Corporate Investment in the US", Butterworths, London, 1988

Eason, R.J., "Statistical Aspects of Costing Alternative Forms of Corporation Tax", Inland Revenue, 1982

Eckbo, E., and Langohr, H., "Disclosure Regulations and Determinants of Takeover Premiums", UCLA Working Paper, May 1989

Edwards, J.S.S., Mayer, C.P., "Issues in Bank Taxation", IFS Report, No. 5, 1983

Edwards, J.S.S., Mayer, C.P., Pashardes, P., Poterba J., "The Effects of Taxation on Corporate Dividend Distributions", IFS Working Paper No. 78, 1985

Edwards, J.S.S., Keen M.J., "Taxation, Investment and Marginal q", Review of Economic Studies, 52, 1985, pp665–79

Edwards, J.S.S., Keen, M.J., "Inflation and Non–neutralities in the Taxation of Corporate Source Income", Oxford Economic Papers, 37, 1985, pp552–75

Elton, E.J., Gruber, M.J., "Marginal Stockholder Tax Rates and the Clientele Effect", Review of Economics and Statistics, 52, No.1 Feb 1970, pp68–74

Elton, E.J., Gruber, M.J., "Taxes and Portfolio Composition", Journal of Financial Economics, V, Dec 1978, pp399–410

Feldstein, M.S., "Corporate Taxation and Dividend Behaviour", Review of Economics Studies, 37, pp57–72

Feldstein, M.S., Summers, L., "Inflation and the Taxation of Capital Income in the Corporate Sector", National Tax Journal, 1979

Feldstein, M.S., Summers, L., "Inflation and the Taxation of Capital Income in the Corporate Sector: A Reply", National Tax Journal, 1980

Fellingham, J.C., Wolfson, M.A., "The Effects of Alternative Income Tax Structures on Risk Taking in Capital Markets", National Tax Journal, 1978

Ferri, M., Jones, W., "Determinants of Financial Structure: A New Methodical Approach", Journal of Finance, June 1979

Fishman, M.J., "Pre–emptive Bidding and the Role of the Medium of Exchange in Acquisitions", Journal of Finance 44, 1989, pp41–58

Flath, D., Knoeber, C., "Taxes, Failure Costs, and Optimal Industry Capital Structure: An Empirical Test", Journal of Finance, March 1980

Foster, G., "Financial Statement Analysis", Prentice–Hall, 2nd Ed, 1986

Franks, J.R., Harris, R., and Mayer, C., "Means of Payment in Takeovers: Results for the United Kingdom and the United States", in Auerbach (1988), 1988, pp221–258

Franks, J.R., Hodges, S.D., "Valuation of Financial Lease Contracts: A Note", Journal of Finance, 33, No.2, May 1978, pp657–669

Franks, J.R., Hodges, S.D., "Lease Valuation when Taxable Earnings are a Scarce Resource", Working Paper, June 1985

Friend, I., Hasbrouck, J., "Determinants of Capital Structure", 1988, in (1985) Research in Finance, Volume 7, A Chen (ed), pp1–19

Friend, I., Long, L., "An Empirical Test of the Impact of Managerial Self–Interest on Corporate Capital Structure", 1988, Journal of Finance 43, pp271–281

Fullerton, D., "Which effective tax rate?", National Tax Journal, 37, 1984, pp23–42

Fung, W.K.H., and Theobald, M.F., "Dividends and Debt under Alternative Tax Systems", Journal of Financial and Quantitative Analysis 19, March 1984, pp59–72

Galai, D., "Corporate Income Taxes and the Valuation of Claims on the Corporation", Working Paper, July 1983

Galai, D., Masulis, R., "The Option Pricing Model and the Risk Factor of Stock", Journal of Financial Economics 3, January/March 1976, pp53–81

Gordon, M.J., "The Investment, Financing and Valuation of a Corporation", Homewood, Illinois: Irwin, 1962

Gordon, R.H., Bradford, D., "Taxation and Stock Market Valuation of Capital Gains and Dividends", Journal of Public Economics, XIV, October 1980, pp109–39

Goudie, A.W., "Tax Exhaustion: Estimates from a Disaggregated Model of Corporate Tax Liabilities", Applied Economics, vol 16, No.2, 1983

Goudie, A.W., Meeks, G., "Individual Agents in a Macroeconomic Model", 1985

Gravelle, J.G., "Inflation and the Taxation of Capital Income in the Corporate Sector", National Tax Journal, 1980, pp473–484

Green, R.C., Talmor, E., "The Structure and Incentive Effects of Corporate Tax Liabilities", Journal of Finance, 40, 1983, pp1095–114

Green, R.C., "Investment Incentives, Debt, and Warrants", 1984, Journal of Financial Economics 13, pp115–136

Green, R.C., Talmor, E., "The Effects of Tax Asymmetries on the Scale of Corporate Investment", in J.S.S. Edwards, J.R. Franks, C.P. Mayer and S.M. Schaefer (eds) Recent Advances in Corporate Finance, Cambridge: Cambridge University Press, 1987

Grossman, S.J., Hart, O., "Corporate Financial Structure and Managerial Incentives", The Economics of Information and Uncertainty, J McCall (ed), Chicago University of Chicago Press, 1982

Haley, C., Schall, L., "The Theory of Financial Decisions", 2nd Edition, New York: McGraw–Hill, 1979

Hamada, R., "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks", Journal of Finance, May 1972

Hannah, S., Higson, C.J., "Mr Lawson's Tax Bonanza", County Natwest Economic Bulletin, Feb 1988

Hansen, R.G., "A Theory for the Choice of Exchange Medium in Mergers and Acquisitions", Journal of Business No.60, 1987, pp75–95

Harris, M., Raviv, A., "The Theory of Capital Structure", Journal of Finance, March 1991, pp297–356

Hasbrough, J., "The Impact of Inflation Upon Corporate Taxation", National Tax Journal, 1983

Haugen, R.A., and Senbet, L.W., "The Insignificance of Bankruptcy Costs to the Theory of Optimal Capital Structure", Journal of Finance 33, June 1978, pp383–93

Hayashi, F., Inoue, T., "Implementing the Q theory of investment in micro data: Japanese manufacturing 1977–1985", 1987, mimeo, Osaka University

Hayn, C., "Tax Attributes as Determinants of Shareholders Gains in Corporate Acquisitions", Journal of Financial Economics 23, 1989, pp121–153

Heinkel, R., and Schwartz, E., "Rights versus Underwritten Offerings: As Asymmetric Information Approach", Journal of Finance 41, 1985, pp1–18

Higson, C.J., "The Effective Rate of Corporation Tax for UK Companies", LBS mimeo, 1987a

Higson, C.J., "What has happened to the UK Stock/Output Ratio?", LBS mimeo, 1987b

Higson, C.J., "A Model of Corporate Financial Decisions When There is Tax Exhaustion", LBS mimeo, 1990

Higson, C.J., "Estimates of Effective Corporate Tax Rates for UK Companies", LBS IFA Working Paper, 1991

Higson, C.J., Holly S., "Macroeconomic and Microeconomic modelling: Some Issues.' in 'Disagreggation in Economic Modelling." (Eds. T. Barker and H. Pesaran), Cambridge University Press, Cambridge. 1990

HMSO, "Corporation Tax, Green Paper, Cmnd 8456, 1982
(various years), "Corporation Tax", Green Paper, Cmnd 8456
(various years), "CSO Blue Book"
(various years), "Inland Revenue Statistics"
(various years), "Report of the Board of Inland Revenue"
(various years), "Finance Act"

Hodges, S.D., Schaefer, S.M., "A Model for Bond Portfolio Improvement", Journal of Finance and Quantative Analysis, 12, No.2, June 1977

Hong, H., Kaplan, R.S., and Mandelker, G., "Pooling vs Purchase: The Effects of Accounting for Mergers on Stock Prices", The Accounting Review, 1978, pp31–47

Huang, Y., and Walking, R.A., "Target Abnormal Returns Associated with Acquisition Announcements: Payouts, Acquisition Form and Managerial Reistance", Journal of Financial Economics, 19 December 1987, pp329–349

Inland Revenue, "The Computer Simulation Model for Forecasting and Costing Corporation Tax in the United Kingdom", 1982

Institute of Chartered Accountants, "The Treatment of Taxation under the imputation system in the accounts of companies", revised, SSAP 8, 1977

Institute of Chartered Accountants, "Accounting for Deferred Tax", revised, SSAP 15, 1985

Jalilvand, A., Harris, R.S., "Corporate Behaviour in Adjusting Capital Structure and Dividend Policy: An Econometric Study", Journal of Finance 39, March 1984, pp127–145

Jensen, M.C., "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers", American Economic Review, Vol 76, No 2, May 1986, pp323–329

Jensen, M.C., Meckling, W.H., "Theory of the Firm Managerial Behaviour, Agency Costs and Ownership Structure", Journal of Financial Economics, October 1976, pp305–360

Jensen, M.C., and Ruback, R.S., "The Market for Corporate Control: The Scientific Evidence", Journal of Financial Economics 11, 1983, pp5–50

Joines, D.H., "Estimates of Effective Marginal Tax Rates on Factor Incomes", Journal of Business 54, 1981, pp191–226

Kaldor, N., "The Economic Effects of Alternative Systems of Corporation Tax", Report of the Select Committee on Corporation Tax, 1971, Appendix 15, House of Commons Paper 622, HMSO

Kale, J.R., Noe, T.H., Ramirez, G.G., "The Effect of Business Risk on Corporate Capital Structure: Theory and Evidence", Journal of Finance, Dec 1991, pp1693–1716

Keen, M., Schiantarelli, F., "Corporation Tax Asymetrices and Optimal Financial Policy", IFS Working Paper 88/2, IFS, London

Kester, W.C., "Capital and Ownership Structure: A Comparison of United States and Japanese Manufacturing Corporations", Financial Management, vol 15, no. 1, Spring 1986, pp5–16

Kim, E.H., "A Mean–variance Theory of Optimal Capital Structure and Corporate Debt Capacity", Journal of Finance 33, 1978, pp45–63

Kim, E.H., "Miller's Equilibrium, Shareholder Leverage Clienteles and Optimal Capital Structure", Journal of Finance, 37, May 1982, pp301–19

Kim, E.H., Lewellen, W., McConnell, J., "Financial Leverage Clienteles: Theory and Evidence", Journal of Financial Economics 7, March 1979, pp83–109

Kim, W.S., Sorensen, E.H., "Evidence on the Impact of the Agency Costs of Debt in Corporate Debt Policy", 1986, Journal of Financial and Quantitative Analysis 21, pp131–144

King, M.A., "Corporate Taxation and Dividend Behaviour – A Comment", Review of Economic Studies, 38, 1971 pp377–80

King, M.A., "Taxation and the cost of capital", Review of Economic Studies, 41, 1974, pp21–35

King, M.A., "Taxation, Corporate Financial Policy and the Cost of Capital – A Comment", Journal of Public Economics, 1975, pp271–279

King, M.A., "Public Policy and the Corporation", London, Chapman and Hall, 1977

King, M.A., Fullerton, D., "The Taxation of Income from Capital: a comparative study of the United States, the United Kingdom, Sweden, and West Germany", Chicago and London, University of Chicago Press, 1984

King, J.R., "Taxes and the cost of capital", 1985, mimeo, Institute for Fiscal Studies:

London

King, J.R., "The OECD Model Firm: Some Extensions and a UK Illustration", IFS Working Paper, No.88, 1986

King, M., "Takeovers, Taxes and the Stock Market", London School of Economics, Mimeo, 1986

Kirkman, P.R.A., and Usher, J., "Recent Developments in Preference Share Finance", Journal of Business Finance 3, 1971, pp911–21

Kraus, A., Litzenberger, R.H., "A State–preference model of Optimal Financial Leverage", Journal of Finance, 28, September 1973, pp911–22

Lewellen, W.G., Long, M.S., McConnell, J.J., "Asset Leasing in Competitive Capital Markets", Journal of Finance 31, No.3, June 1976, pp787–798

Lev, B., "Industry Averages as Targets for Financial Ratios", Journal of Accounting Research 7, Autumn 1969, pp290–99

Levis, M., Morgan, E.J., "The 1984 Budget: Effects of Corporate Tax and Investment", IFS Working Paper, No.88, 1985

London Business School, "Financial Databases: Reference Manual", 1986

Long, M.S., Malitz, E.B., "Investment Patterns and Financial Leverage", Working Paper, National Bureau of Economic Research, 1983

Long, M., Malitz, L., "Investment Patterns and Financial Leverage", In B. Friedman, ed., Corporate Capital Structure in the United States, Chicago: University of Chicago Press, 1983, p138

Long, M., Malitz, I., "The Investment–Financing Nexus: Some Empirical Evidence", 1985, Midland Corporate Finance Journal 3, pp53–59

Majd, S., Myers, S.C., "Valuing the Government's Tax Claim on Risky Corporate Assets", National Bureau of Economic Research Working Paper, No.1553, 1985

Marsh, P.R., "The Choice between Equity and Debt: An Empirical Study", Journal of Finance 37, March 1982, pp121–44

Marsh, P.R., "Equity Rights Issued and the Efficiency of the UK Stock Market", Journal of Finance 34, 1979, pp839–62

Masulis, R.W., "The Effects of Capital Structure Change on Security Prices: A Study of Exchange Offers", Journal of Financial Economics, Vol 8, No. 2, June 1989, pp139–177

Masulis, R.W., "The Debt–Equity Choice", New York, Ballinger Publishing Co., 1988

Martin, J.D., Scott, D.F., "A Discriminant Analysis of the Corporate Debt–Equity Decision", Financial Management, Winter 1974, pp71–79

Mayer, C.P., The Structure of Corporation Tax in the UK", Fiscal Studies, 1982

Mayer, C.P., "Corporation Tax, Finance and the Cost of Capital", Review of Economic

Studies, 1986

Mayer, C.P., Meadowcroft, "A Company Accounts Database", Mimeo, 1982

Mayer, C.P., Meadowcroft, "Equity Rates of Return in the UK – evidence from panel data", IFS Working Paper No. 51, 1984

Mayer, C.P., Morris, C.N., "A Disaggregated Model of UK Corporation Tax", IFS Working Paper, No.33, 1982

Mayer, C.P., Morris, C.N., "Marginal Rates of Corporation Tax: A Disaggregated Analysis", Fiscal Studies, July 1983, pp142–160

McGugan, V., Caves, R., "Integration and Competition in the Equipment Leasing Industry", Journal of Business, 47, No.3, July 1974, pp382–396

Miller, M.H., Upton, C.W., "Leasing, Buying and the Cost of Capital Services", Journal of Finance, 31, No.3, June 1976, pp761–786

Miller, M.H., "Debt and Taxes", Journal of Finance, 1977, pp261–275

Miller, M.H., "The Modigliani–Miller Propositions After Thirty Years", 1988, Journal of Economic Perspectives 2, pp99–120

Miller, M.H., "The Corporation Income Tax and Corporate Financial Policies", In Stabilization Policies, Commission on Money and Credit, 1963

Miller, M.H., and Scholes, M.S., "Dividends and Taxes", Journal of Financial Economics 6, December 1978, pp333–64

Modigliani, F.F., Miller, M.H., "The Cost of Capital, Corporation Finance and the Theory of Investment", American Economic Review, 48, 1958, pp261–297

Modigliani, F.F., Miller, M.H., "Corporate Income Taxes and the Cost of Capital: A correction", American Economic Review, 53, June 1963, pp433–43

Myers, S.C., "Determinants of Corporate Borrowing", Journal of Financial Economics 5, November 1977, pp146–175

Myers, S.C., "The Search for Optimal Capital Structure", Midland Corporate Finance Journal 1, Spring 1984, pp6–16

Myers, S.C., The Capital Structure Puzzle", Journal of Finance, 39, July 1984, pp575–592

Myers, S.C., Dill, D., Bautista, A., "Valuation of Financial Lease Contracts", Journal of Finance 31, No.3, June 1976, pp799–819

Myers, S.C., Majluf, N., "Corporate Financing and Investment Decisions When Firms Have Information Investors Do Not Have", Journal of Financial Economics, Vol. 13, No. 2, June 1984, pp187–221

Myers, S.C., Pogue, G.A., "A Programming Approach to Corporate Financial Management", Journal of Finance 29, May 1974, pp579–99

McConnell, J.J. Schallheim, "Valuation of Asset Leasing Contracts", Journal of Financial Economics, 12, January 1983, pp237–261

Nickell, S., "Biases in Dynamic Models with Fixed Effects", Econometrica,Vol 49, No.6, November 1981, pp1417–1426

Niden, C.M., "The Role of Taxes in Corporate Acquisitions: Effects on Premium and Type of Consideration", Unpublished PhD dissertation, University of Chicago, 1988

Pakes, A., "On Group Effects and Errors in Variables in Aggregation", The Review of Economics and Statistics, Vol LXV, No. 1, February 1983, pp168–173

Park, S.Y., Williams, J., "Taxes Capital Structure and Bondholders Clienteles", Unpublished Manuscript, November 1982

Peles, Y.C., Sarnat, M., "Corporate Taxes and Capital Structure: Some Evidence Drawn from the British Experience", Review of Economics and Statistics, 1978, pp118–120

Pitts, A.C., Franks, J.R., "Asymmetric Taxes, Mergers, and Risktaking", LBS Working Paper, October 1984

Poterba, J., "Public Policy and Corporate Dividend Behaviour: The Postwar British Experience", MIT Working Paper No.339, Cambridge MA, 1984

Poterba, J.M., Summers, L., "Dividend Taxes, Corporate Investment and Q", Journal of Public Economics, 22, 1983, pp135–67

Poterba, J., Summers, L., "The Economic Effects of Dividends Taxation", National Bureau of Economic Research, Working Paper, No. 1353, 1984

Protopapadakis, A., "Some Indirect Evidence on Effective Capital Gains Tax Rates", Journal of Business, 56, April 1983, pp127–38

Pyle, D., "Is Deep Discount Debt Financing a Bargain?", Reprint No.61, Berkeley: University of California, Berkeley, Institute of Business and Economic Research, 1982

Remmers, L., Stonehill, A., Wright, R., Beckhuiser, T., "Industry and Size as Debt Ratio Determinants in Manufacturing Internationally", Financial Management, Summer 1974

Robson, M.H., "Corporate Cost of Capital, Tax Loses and the Finance Act 1984", MPhil Thesis, Oxford, 1985

Ross, S., "The Determination of Financial Structures: The Incentive Signalling Approach", Bell Journal of Economics 8, pp23–40, 1977

Ruback, R.S., "An Economic View of the Market for Corporate Control", Delaware Journal of Corporate Law 9, 1984, pp613–625

Rutterford, J., "An empirical investigation of the effects of corporate and personal taxation on company capital structure", Unpublished PhD thesis, June 1986

Sametz, A.W., "Trends in the Volume and Composition of Equity Finance", Journal of Finance 19, September 1964, pp450–69

Schaefer, S.M., "Tax–Induced Clientele Effects in the Market for British Government

Securities: Placing Bounds on Security Values in an Incomplete Market", Journal of Financial Economics 10, No.2, July 1982 (a), pp121–159

Schaefer, S., "Taxes and Security Market Equilibrium", Journal of Financial Economics, 1982

Scholes, M.S., "The Market for Securities: Substitution versus Price Pressure and the Effects of Information on Share Prices", Journal of Business 45, April 1972, pp179–211

Schwartz, E., and Aronson, J.R., "Some Surrogate Evidence in Support of the Concept of Optimal Capital Structure", Journal of Finance 22, March 1967, pp10–18

Scott, J.H., "A Theory of Optimal Capital Structure", Bell Journal of Economics, 7, Spring 1976, pp33–54

Siegfried, J., "Effective Average US Corporation Income Tax Rates", National Tax Journal 27, 1974, pp245–59

Silver, A., "Original Issue Deep Discount Bonds", Federal Reserve Bank of New York Quarterly Review 6, Winter 1981–82, pp18–28

Smirlock, M., Marshall, W., "An Examination of the Empirical Relationship between the Dividend and Investment Decisions: A Note", The Journal of Finance, Vol 83, 1983, pp1659–1667

Smith, C., Warner, J., "On Financial Contracting", 1979, Journal of Financial Economics 7, pp117–161

Smith, C.W., "Alternative Methods for Raising Capital: Rights Versus Underwritten Offerings", Journal of Financial Economics 5, 1977, pp273–307

Sorensen, I., Johnson, R.E., "Equipment Financial Leasing Practices and Costs: An Empirical Study", Financial Management, 6, No.1, Spring 1977, pp33–40

Stapleton, R. C., "Taxes, the Cost of Capital and the Theory of Investment", The Economic Journal 82, 1972, pp1273–92

Stiglitz, J.E., "A Re–examination of the Modigliani–Miller Theorem", American Economic Review, 59, 1969, pp784–93

Stiglitz, J.E., "Taxation, Corporate Financial Policy and the Cost of Capital", Journal of Public Economics, 2, 1973, pp1–34

Stulz, R. M., "Managerial Discretion and Optimal Financing Policies", Working Paper, Ohio State University, June 1990

Sumner, M., "The Effect of Anticipated Tax Change on Investment in Britain", mimeo, 1985

Taggart, R., "A Model of Corporate Financing Decisions", Journal of Finance 32, December 1977, pp1467–84

Taggart, R., "Taxes and Corporate Capital Structure in an Imcomplete Market", Journal of Finance, 35, June 1980, pp645–59

Taggart, R., "Secular Patterns in the Financing of Corporations", In B.M. Friedman, ed., Corporate Capital Structures in the United States", Chicago: University of Chicago Press, 1985

Talmor, E., Haugen, R., Barnea, A., "The Value of The Tax Subsidy on Risky Debt", Journal of Business, 1985

Taub, A., "The Determinants of the Firm's Capital Structure", Review of Economics and Statistics 57, November 1975, pp410–16

Teasedale, M., Devereux, M.P., "Corporation Tax: assessment and payment lags", mimeo, 1985

Titman, S., "The Effect of Capital Structure on a Firm's Liquidation Decision", Journal of Financial Economics, Vol. 13, No.1, March 1984, pp137–151

Titman, S., Wessels, R., "The Determinants of Capital Structure Choice", Journal of Finance, Vol. 43, No. 1, March 1988, pp1–19

Toy, N., Stonehill, A., Rimmers, L., Wright, R., and Beckhuisen, T., "A Comparative International Study of Growth, Profitability and Risk as Determinants of Corporate Debt Ratios in the Manufacturing Sector", Journal of Financial and Quantitative Analysis, November 1974.

Travlos, N.G., "Corporate Takeover Bids, Methods of Payment and Bidding Firms' Stock Returns", Journal of Finance 42, September 1987, pp943–963

Trczinka, C., "The Pricing of Tax–exempt Bonds and the Miller Hypothesis", Journal of Finance, 37, September 1982, pp907–32

Tolleys, (various years), "Corporation Tax"

Tolleys, (various years), "Double Taxation Relief"

Tolleys, (various years), "Income Tax"

Turnbull, S.M., "Debt Capacity", Journal of Finance, 34, September 1979, pp931–40

Van Horne, J., "Implicit Tax Rates and the Valuation of Discount Bonds", Journal of Banking and Finance, 6, June 1982, pp145–59

Wansley, J., Lane, W., and Yang, H., "Abnormal Returns to Acquiring Firms by Type of Acquisition and Method of Payment", Financial Management 12, 1983, pp16–22

Warner, J.B., "Bankruptcy Costs: Some Evidence", Journal of Finance, 32, 1977, pp337–347

Warren, A.C., and Auerbach, A.J., "Transferability of the Tax Incentives and the Fiction of Safe–harbor Leasing", Harvard Law Review, 95, June 1979, pp1752–86

Williamson, S., "The Moral Hazard Theory of Corporate Financial Structure: An Empirical Test", Unpublished PhD Dissertation, MIT, 1981

Zwick, B., "The Market for Corporate Bonds", Federal Reserve Bank of New York Quarterly Review, Autumn 1977, pp27–36.