Corporate capital structure in the United Kingdom: determinants and adjustment

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Abstract

In this paper three contributions are made. First, empirical support is provided for the 'trade-off' model of corporate capital structure where companies borrow to take advantage of the tax benefits of debt, which they set against possible costs of overindebtedness. Second, it is shown empirically how companies adjust their balance sheets when borrowing is out of equilibrium, through adjustments to dividend payments, new equity issues and to a lesser extent capital investment. Third, these factors are incorporated within an aggregate model that quantifies the process and speed of balance sheet adjustment in the economy as a whole.

Key words: Capital structure, gearing, tax, balance sheet adjustment.

JEL classification: C51, D92, G32, H25, H32.

Summary

The balance sheet position of non-financial companies goes through phases of strength and weakness. At the end of 2003 the amount of debt on corporate balance sheets was at a historically high level in relation to the market value of the capital that ultimately provides the means by which the debt is serviced. Past patterns would suggest that such high gearing situations do not persist and that companies act to bring down their indebtedness. This paper addresses the factors that determine the level of gearing that companies appear to aim for over time and what actions companies take to adjust when their debt gets out of line with their desired level.

Our analysis provides an empirical test of the 'trade-off' theory of corporate capital structure, which suggests that firms have an equilibrium level of capital gearing that is determined by trading off the advantages of holding debt against the expected costs of financial distress, which becomes more likely at high debt levels. We consider only the tax benefits of holding debt, since the other factors that make debt an attractive form of business finance are difficult to quantify. The tax advantage of debt arises from the deductibility of interest payments against corporation tax payments, but the magnitude of the benefit depends in a complex way on the personal tax rates faced by shareholders. This paper uses a theoretical model of corporate behaviour to derive an expression for the tax gains to corporate gearing, which we construct for the United Kingdom from 1970 onwards and use as a basis for the empirical part of the paper. The tax gains to gearing were high in the second half of the 1970s and the early 1980s when corporation tax rates were high, but they have fallen since and are currently at a historically low level.

We find evidence that firms in the United Kingdom have target levels of capital gearing at the aggregate level, which in the long run depend on the tax advantages of debt and on the probability of bankruptcy (which will be related to the expected costs of financial distress). This finding provides empirical support for the 'trade-off' theory of corporate capital structure, and it reinforces the results of previous firm-level work at the Bank which also found that firms have target levels of gearing. The current level of long-run equilibrium capital gearing at market value for the UK PNFC sector implied by our model is approximately 16%.

The paper then goes on to test how firms adjust their balance sheets to eliminate deviations in actual gearing from the implied equilibrium level. We find that most of the adjustment in response to above-equilibrium gearing takes place through reduced dividend payments and increased equity issuance. There is only weak evidence that firms adjust through more restrained capital investment. This is consistent with the 'new view' of corporate behaviour which suggests that real adjustment will only take place once dividends cannot be reduced any further. These findings are also consistent with firm-level work for the United Kingdom which has found evidence of adjustment in dividends and new equity issuance, with the proviso that investment appears to be more responsive to a flow measure of financial pressure than a stock measure of balance sheet disequilibrium.

Illustrative simulations show how firms may adjust their balance sheets in response to shocks that move gearing further away from its implied equilibrium. Although firms appear to respond

quickly and make relatively large adjustments to the flows, the actual adjustment process is likely to be protracted because the flows of dividends, equity issuance and investment are all small in relation to the stock of debt.

1. Introduction[1]

The balance sheet position of non-financial companies goes through phases of strength and weakness. At the end of 2003 the amount of debt on corporate balance sheets was at a historically high level in relation to the market value of the capital that ultimately provides the means by which the debt is serviced. Past patterns would suggest that such high gearing situations do not persist and that companies act to bring down their indebtedness. This paper addresses the issue of what determines the level of gearing that companies appear to aim for over time and what actions companies take to adjust their debt when it gets out of line with their desired level.

These questions are closely related to the academic literature on capital structure that asks whether there exists an equilibrium level of gearing for individual companies and, if so, what determines it. Since Modigliani and Miller (1958) showed the conditions under which a company's choice of capital structure does not affect its overall valuation, considerable research effort has been devoted to showing the effect on capital structure when these conditions are relaxed. A recent survey of this literature is Myers (2001). Despite much progress theoretically, Rajan and Zingales (1995) claim that 'very little is known about the empirical relevance of the different theories'. One of the aims of this paper is to test the relevance in the United Kingdom of one of the key theoretical approaches to modelling the choice of capital structure, namely the so-called 'trade-off' model.

The 'trade-off' model states that in their choice of capital structure, companies seek to balance the benefits of debt against the potential costs of financial distress that is made more likely at high debt levels. Tax benefits from debt derive from the deductibility of interest from corporate source income, but the effect of this on corporate valuations also depends in a complicated way on the personal taxes faced by shareholders (Auerbach (2002)). The wide historical variation in corporate and personal tax rates over time in the United Kingdom makes it possible to assess whether changes in the tax benefits of corporate debt have caused companies to vary their desired level of gearing. An important contribution of this paper is that we find a significant effect of both tax incentives and a measure of bankruptcy risk on the desired level of corporate debt, in line with the 'trade-off' model. While this does not rule out the relevance of other theories of capital structure which are more difficult to test, it provides evidence in favour of the view that tax incentives and expected costs of distress have important effects on corporate financial decisions.

It is also clear that disequilibria in corporate debt levels can persist for relatively long periods. This reflects the fact that stocks of debt are typically large in relation to the flows that companies need to adjust if they are to affect the stocks. As such, the process of adjusting indebtedness to an equilibrium level can have important repercussions as it must involve either new injections of equity or cut-backs in outgoings with a range of possible implications for employees, shareholders, suppliers and the macroeconomy. This paper explores the process of balance sheet adjustment at the aggregate company sector level, building on the earlier firm-level analysis of Benito and Young (2002). Benito and Young examine the process of adjustment through changes in capital investment, dividend payments and new equity issues. This paper analyses whether

[1] An earlier, less technical version of this paper was published in Bunn and Young (2003).

these relationships also hold at the aggregate level. A further contribution of the paper is to show that adjustment mainly occurs through changes in financial factors, like dividends, with less robust evidence of effects on real factors, like capital investment.

The results make it possible to take account of the way companies actively control their balance sheets in forecasting and policy analysis. A key tool for this is the extension to the Bank's medium-term macroeconomic model (MTMM) described in Benito, Whitley and Young (2001). In its initial formulation, this model assumes that company financial behaviour is determined by simple relationships that allow no feedback from the corporate balance sheet. As such the model is not closed in that the balance sheet is not controlled and indebtedness can accumulate or decumulate without limit. This paper uses the aggregate evidence to introduce feedback from disequilibrium stocks onto flows into the model, increasing its usefulness as an analytical tool. Importantly, the model now shows the effect of corporate balance sheet adjustment on macroeconomic outcomes.

The paper is structured as follows. Section 2 outlines the 'trade-off' model and presents a theoretical framework used to determine the equilibrium capital structure of individual firms. Section 3 uses the theoretical model as the basis of an empirical test of the relationship between the tax gains from gearing, bankruptcy risk and corporate sector capital gearing. A statistically significant relationship is found which is used to infer the long-run equilibrium level of capital gearing. This is used to define disequilibrium gearing as the difference between observed gearing and implied equilibrium gearing. We then explore a number of hypotheses regarding the way in which the corporate sector acts so as to bring capital gearing back towards its equilibrium value. Section 4 presents the results for dividends, Section 5 looks at net equity finance, and Section 6 investment. In Section 7 we look at the simulation properties of the MTMM when the new equations are incorporated within it. Section 8 concludes the paper.

2. Theoretical framework

According to Myers (2001), 'there is no universal theory of the debt-equity choice, and no reason to expect one'. In this section, we use one possible model of capital structure to provide the framework for our subsequent empirical investigation of the determinants of equilibrium gearing and the means of adjustment to it.

Our analysis is based on the 'trade-off' theory of capital structure in which firms trade off the benefits of debt against the expected costs of financial distress (Barclay *et al* (1995), Myers (2001)). Discussion of the 'trade-off' theory is often restricted to the tax advantages of debt, which arise due to differences in the rate at which income is taxed at the corporate and shareholder level, partly due to the tax deductibility of corporate interest payments (Auerbach (2002)). This is discussed in more detail later in this section. But there are other factors which make debt an attractive method of business finance. First, asymmetries in information between managers and outside investors tend to encourage debt issuance, and these asymmetries are more acute for equity investors whose return depends on the performance of the company, than for debt providers whose returns are usually specified in advance. Investors may undervalue new equity issues because of the possibility that managers may take advantage of their better knowledge about the true state of the business when selling equity (Myers and Majluf (1984)). The undervaluation of equity issues will increase the attractiveness of debt relative to equity finance. Second, in the absence of debt companies would generate larger amounts of cash that would then be at the disposal of the management. Shareholders might worry that managers would use this to consume 'perks' rather than maximise the return for shareholders. As such, one of the advantages of debt is that it limits free cash flow available to managers (Jensen and Meckling (1976)). Third, debt is preferred by entrepreneurs who do not wish their control rights to be diluted, as would be the case with new equity issues (Hart (2001)).

If there were no costs to holding debt, the benefits described above would imply all firms hold 100% debt and no equity. However, increasing debt also raises the expected costs of financial distress. These depend on both the probability that a firm will suffer distress and the magnitude of the costs should the firm suffer distress. The costs of financial distress include both the direct costs of re-organisation in the event of insolvency as well as the indirect costs that arise when firms get into financial difficulty.

The 'trade-off' theory implies there will be an equilibrium level of debt in which any further increase in indebtedness will raise the expected costs of distress by more than the additional benefit of that extra borrowing. But the concept of an equilibrium level of debt is not consistent with all models of capital structure in the finance literature. The main competing theory, the 'pecking order' model of Myers and Majluf (1984) asserts that borrowing is always preferred to new equity issues because all other costs and benefits of holding debt are second order in relation to the effects of asymmetric information on the terms on conditions of equity finance. Therefore, 'changes in debt ratios are driven by the need for external funds, not by an attempt to reach an optimal capital structure' (Shyam-Sunder and Myers (1999)).

The framework

The main purpose of the model presented here is to show how the tax advantage of debt arises, and to derive a measure for use in our empirical analysis. The model does not explicitly consider the possible effects on capital structure of asymmetric information, agency, control issues or costs of financial distress. We do this to allow us to focus on explaining the tax benefits which are less intuitive than the other variables, but more quantifiable, although most of the implications we describe could still be applied to a model with these additional variables.

The model is based on the 'new view' analysis of corporate behaviour set out originally by King (1977) and Auerbach (1979) and surveyed recently in Auerbach (2002). In this model, differential taxation of corporate and personal income causes companies to have a definite preference for one form of investment finance over another and may affect the cost of capital and so their real investment decisions. A critical prediction of the new view is that firms obtain their equity funds for investment through the retention of earnings, and distribute residual funds as dividends, rather than using new equity as the marginal source of finance as predicted by the traditional view. This approach is extended slightly here to allow the rate of interest on corporate borrowing to be increasing in the amount borrowed, to reflect the possible costs of debt finance. We begin by describing the model formally, before going on to discuss its general implications for the United Kingdom. We assume throughout that managers attempt to maximise the stock market valuation of the firms under their control subject to a wide number of constraints, including possible borrowing constraints.

The framework allows for distinct corporate and personal tax systems which are partially integrated by an imputation system that provides tax credits to shareholders on dividends received.(2) Suppose that the market value of a company's equity is determined by the arbitraging activities of risk-neutral investors. The return to holding the company's equity for one period is then equal to what could be earned on other assets:

$$\left(1+\left(1-\tau^{m}\right)r_{t}\right)E_{t}=\left(1-\tau^{m}\right)D_{t}+(E_{t+1}-N_{t})-g^{m}(E_{t+1}-N_{t}-E_{t}) \qquad \textbf{(1)}$$

where r is the one-period nominal interest rate, τ^m is the personal income tax rate, g^m is the personal capital gains tax rate, E is the value of equity in the company at the beginning of the period, D is the value of dividends paid out (including tax credits) at the end of the period and N is the net value of equity issued during the period. The left-hand side is what would be earned after tax at date $t+1$ on an investment of E_t in other assets and the right-hand side is the post-tax return on investment in the firm. This is made up of dividends and capital gains on the equity which excludes the value of equity issued after t.

Re-arranging **(1)** gives an expression for the value of equity as a function of dividends, taxes, the rate of interest and new equity:

$$E_{t}=\frac{(1-\tau^{p})D_{t}+E_{t+1}-N_{t}}{(1+R_{t})} \qquad \textbf{(2)}$$

where $(1-\tau^{p})=\dfrac{(1-\tau^{m})}{(1-g^{m})}$ and $R_{t}=(1-\tau^{p})r_{t}$

This expression shows how future dividends are discounted to determine the value of equity. This plays a vital role in determining the optimal timing of payments between the firm and its shareholders. The other key factor is the rate at which the firm is able to transform current into future resources and this is reflected in the sources and uses identity:

$$D_{t}=\frac{1}{(1-c)}\left[(1-\tau)(\Pi_{t}-r_{t}^{B}B_{t})-(1-\gamma\tau)P_{t}^{I}I_{t}+B_{t+1}-B_{t}+(1-f)N_{t}\right] \qquad \textbf{(3)}$$

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(2) Shareholders in the United Kingdom currently receive a 10% tax credit on dividends paid, where applicable tax is then levied on the gross dividend including the imputed tax credit.

where c is the rate of imputation, τ is the corporate tax rate, Π is the nominal profits of the firm, B is its stock of debt, r^B is the interest rate paid on corporate debt, γ is the present value of investment allowances, P^I is the gross price of investment goods, I is the volume of gross capital investment and f represents the unit cost of issuing new shares.

Optimum policies

The real investment and financial decisions of companies are assumed to be arrived at by maximising **(2)** subject to **(3)** and the following constraints:

a) Real operating profits are a function of the capital stock, where the capital stock is related to cumulated investment by the identity $K_{t+1} = (1-\delta)K_t + I_t$ and δ is the rate of depreciation of capital.
b) Dividends cannot be negative as shareholders cannot be forced to commit extra funds to the firm ($D_t \geq 0$). In practice, there are also upper limits on the size of dividend payments to prevent companies weakening their capital base unduly, although these are not considered in this paper.
c) New equity finance cannot be negative ($N_t \geq 0$). It used to be the case in the United Kingdom (discussed in King (1977)) that public companies were prevented by law from repurchasing their shares. The rules were changed in the 1981 Companies Act and companies are now allowed to repurchase their shares, although many limitations remain. These are mainly to prevent tax avoidance. In particular, for tax purposes a component of any share buy-back is treated in exactly the same way as a dividend distribution while the size of the capital element is negotiable with the Inland Revenue. This can have advantages for companies wishing to 'stream' distributions according to the tax preferences of their different shareholders. The effect from a tax perspective is that share buy-backs can be considered equivalent to dividends rather than a negative new issue of equity. Similar considerations apply in the United States.
d) The supply curve of debt finance is upward sloping in the stock of debt. This can be represented by a simple debt pricing structure whereby the interest rate on debt is r_t for borrowing below a certain threshold B_t^h and r_t^h when debt is above this threshold. The higher rate is intended to reflect any costs, such as possible anticipated insolvency costs, due to high levels of gearing. This is discussed further below.

The Lagrangian can be written as:

$$\begin{aligned}\Lambda_t = E_t &- \sum_{j=0}\mu_{t+j}\left(K_{t+j+1} - (1-\delta)K_{t+j} - I_{t+j}\right) + \sum_{j=0}\lambda_{t+j}(B_{t+j} - B^h_{t+j}) \\ &+ \sum_{j=0}\lambda^D_{t+j}D_{t+j} + \sum_{j=0}\lambda^N_{t+j}N_{t+j}\end{aligned} \qquad \textbf{(4)}$$

where μ is the Lagrange multiplier on the capital constraint, λ, λ^D and λ^N are the Kuhn-Tucker multipliers on the debt, dividend and new issue constraints respectively. The budget constraint and the relationship between profits and capital are imposed by substitution.

The solution of this intertemporal maximisation problem determines the firm's investment and financial decisions. In principle these are joint decisions, but capital investment and financing choices can be independent of each other depending on whether the constraint on dividends is expected to bind at any time. This in turn is related to the various tax incentives faced by the firm. We first discuss these in relation to the firm's financing decisions.

Debt finance

Ignoring the inequality constraints on debt itself, the first-order condition for each type at the beginning of t+1 can be written as:

$$\frac{\left(1-\tau^{p}\right)}{(1+R_{t})(1+R_{t+1})}\left(\frac{(1-\tau^{m})}{(1-g^{m})}r_{t+1}-(1-\tau)r_{t+1}^{B}\right)+\lambda_{t}^{D}-\lambda_{t+1}^{D}(1+(1-\tau)r_{t+1}^{B})=0 \qquad \textbf{(5)}$$

Consider first the case where the company has a small amount of debt so that the interest rate on its debt is equal to the rate of interest at which the holders of its shares can invest their wealth ($r^B = r$). The tax incentives to borrow are then encapsulated in the term in large parentheses (.). This term is used as the basis of a measure of the tax gains from gearing in the empirical section. It shows the overall financial benefit to shareholders of an extra unit of corporate debt, taking account of the other financial opportunities open to shareholders.

The intuition for this expression is as follows. By borrowing more the company is able to pay out a higher dividend at the end of period t in exchange for a lower dividend at the end of period t+1 when the debt is repaid. This is only worthwhile if the gain to shareholders of receiving an early dividend outweighs the decline in the value of their equity stake at t+1. The benefit of an early dividend is that this can be invested providing a net of personal tax return of $(1-\tau^{m})r_{t+1}$; this can be set against the net cost of providing it, $(1-g^{m})(1-\tau)r_{t+1}$. The latter term takes account of the tax deductibility of interest and the saving in capital gains taxation from a lower value of equity when more debt is used. Note that dividend taxes do not affect this comparison provided the tax rate does not change between the two periods.

Thus when the expression in large parentheses (.) is positive the company will wish to borrow more since it can do so at a post-tax rate that is lower than the rate at which its shareholders can lend the proceeds. In effect, it takes advantage of an arbitrage opportunity in favour of its shareholders at the expense of the tax authorities. Other things being equal, the tax gains to corporate gearing will be higher the lower the personal tax rate relative to the capital gains tax. They will also be higher, the higher is the corporation tax rate, since then there will tend to be more company tax payments against which interest can be deducted.

There are two ways in this model by which an equilibrium can be reached and the first-order conditions satisfied in these circumstances where the tax system encourages corporate borrowing. The first is that the company borrows so much that it cannot pay a dividend in the next period, but this would be a difficult equilibrium to sustain since once the company has borrowed and distributed the maximum amount of funds in the first period, its equity would be valueless as all future profits would go to the debtholders.[3] The second, perhaps more likely equilibrium is the second case where the company increases its indebtedness until the cost at which it can borrow increases endogenously to a level high enough that the incentives to further debt finance are eliminated. Thus an internal equilibrium is established by movements in the rate of interest at which lenders are prepared to supply loans to this firm.

The outcome from the model is an equilibrium debt to capital ratio that is determined by the interaction between personal and corporate taxes and factors that determine the terms on which lenders will supply funds. For mature companies, it is likely that dividends are paid in both the current and future periods so that retained profits are the marginal source of investment funds. But as shown in **(5)**, temporary shocks which cause the dividend constraint to bind in the current period could also encourage firms to borrow more than the equilibrium amount.

In practice, outside the model presented here the expected costs of financial distress can help establish an equilibrium where neither of the above two conditions are met. This will exist where a marginal increase in debt will increase the expected costs of financial distress by more than the tax benefit of the additional borrowing, in line with the predictions of the 'trade-off' theory.

Equity finance

The first-order condition for new equity finance at date *t* indicates that this is affected by taxes and the possible presence of binding financial constraints represented by λ^D and λ^N:

$$\frac{1}{(1+R_t)}\left[\frac{(1-\tau^p)(1-f)}{(1-c)}-1\right]+\frac{\lambda_t^D(1-f)}{(1-c)}+\lambda_t^N=0 \qquad \textbf{(6)}$$

The term in parentheses [.] characterises the tax incentive to issue shares. The intuition can be explained as follows. By the budget constraint **(3)**, a new share issue would generate dividends of $(1-f)/(1-c)$ for every unit issued. By **(2)**, extra dividends derived from a new issue raise the value of equity by $(1-\tau^p)(1-f)/(1-c)-1$. If this is positive, then shareholders gain from higher dividends financed by new issues. Under tax systems like that in the United States where the imputation rate, c is zero this expression is negative for many investors even in the absence of costs of new equity ($f = 0$). This means it would never be optimal under the assumed conditions for US companies to issue new shares *and* make dividend payments, since this incurs a gratuitous tax liability which could be avoided by not paying dividends.[4] In these circumstances, the non-negativity constraint on new issues would bind (and the positive value of λ^N could be inferred from the equation). The only circumstance where new shares would be issued with these parameters is when companies face a binding dividend constraint ($\lambda^D > 0$) as might be the case for cash poor 'immature'

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[3] In this case the Lagrange multiplier on the dividend constraint at date $t+1$ would bind and the first-order condition in equation **(5)** would be satisfied.

[4] Indeed, it would be optimal for companies to use the proceeds available to pay dividends to buy back shares. But, as discussed earlier, there is an asymmetry in the tax treatment of share buy-backs that eliminates the advantage of this.

companies. Then companies might issue new shares despite their tax disadvantage to generate funds for another purpose such as to finance investment or to pay off debt.

Capital demand

The first-order conditions for investment at date t and the capital stock at date t+1 are:[5]

$$\frac{\partial \Lambda_t}{\partial I_t} = \frac{(1-\gamma\tau)}{(1-c)} P_t^I \left[\frac{(1-\tau^p)}{(1+R_t)} + \lambda_t^D \right] - \mu_t \ = 0 \qquad \textbf{(7)}$$

$$\frac{\partial \Lambda_t}{\partial K_{t+1}} = \frac{(1-\tau)}{(1-c)} P_{t+1} \frac{\partial Q_{t+1}}{\partial K_{t+1}} \left[\frac{(1-\tau^p)}{(1+R_t)(1+R_{t+1})} - \lambda_{t+1}^D \right] - \mu_t \ + (1-\delta)\mu_{t+1} = 0 \qquad \textbf{(8)}$$

Equation **(7)** and its lead can be solved for μ_t and μ_{t+1} and be substituted into **(8)** to derive an expression for the user cost of capital. In the absence of a binding dividend constraint or anticipated changes in tax rates this is of the familiar Hall-Jorgenson form:

$$\frac{\partial Q_{t+1}}{\partial K_{t+1}} = \frac{(1-\gamma\tau)}{(1-\tau)} \left[\frac{(1+R_{t+1})}{(1+\text{inf}_t^I)} - (1-\delta) \right] \frac{P_{t+1}^I}{P_{t+1}} \qquad \textbf{(9)}$$

where inf_t^I is the rate of inflation in capital goods prices.

This states that in equilibrium, the optimum capital stock is chosen so that the marginal product of capital is equal to its user cost. This is independent of dividend taxes, and the discount rate used is the rate at which the firm's shares are discounted.

As the firm's problem is specified, investment decisions depend on its financing *only* when the dividend constraint is binding. Otherwise, dividends can be adjusted at the margin to ensure that investment projects that promise a return in excess of the cost of capital will take place. But the equilibrium condition is affected by the presence of binding dividend constraints. If the dividend constraint is binding at date t then the cost of capital is raised and this reduces investment at the same date thus taking some pressure off the constraint. Conversely, if the dividend constraint is expected to bind at date t+1 then this reduces the cost of capital at date t since the future profits from current investment can alleviate the constraint.

The relationship between investment and finance

As outlined above, the model has a number of possible solutions depending on relative tax rates and other factors such as transactions costs in issuing equity and supply conditions in the loan market. According to our model new equity issues would have been only used by companies

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[5] Q is output, and $\partial Q/\partial K$ is the marginal product of capital.

facing either low transactions costs or binding dividend constraints. This latter group would include 'immature' companies whose investment opportunities are large relative to the amount of profit they generate. The implication is therefore that the relatively low level of new equity issues observed in the United Kingdom is a result of high transactions costs that have prevented firms from issuing equity, but there may be other factors omitted from the model which could also explain this.

In summary, the model has a number of implications. For mature companies, investment will tend to be independent of how it is financed. Their debt stock will be determined by relative taxes and the supply of loan finance. Dividends will be a residual item responding to cash flow and investment demand.(6) For immature companies, not paying dividends, marginal investment is funded externally and is sensitive to the costs of this. The appropriate choice of funding will depend on the terms on which it is available. Companies might smooth dividends by varying indebtedness or new share issues, but in the long run high dividends in the short term will need to be funded by lower dividends or more new share issues in the future.

The need for balance sheet adjustment

The 'trade-off' model outlined is only one theory of capital structure. But, whatever their motivation, all corporate financial decisions are bound together by the budget constraint linking the sources and uses of funds. Re-arranging **(3)** leads to the following expression for corporate debt:

$$b_{t+1} = \frac{(1+(1-\tau)r_t^B)}{(1+g)} b_t + d_t - n_t + i_t - (1-\tau)\pi_t \qquad \textbf{(10)}$$

where lower-case letters denote shares of the capital stock and g is its nominal growth rate. This difference equation is dynamically unstable when the post corporate tax interest is greater than the growth rate, g.(7) In this case, either dividends, d, new issues, n, investment, i, or profitability, π, need to vary sufficiently to prevent the debt stock and gearing, b, rising or falling without limit. In the model outlined above, dividends would tend to adjust to shocks, although new equity issues and cuts in investment would be used when dividends were cut to zero.(8) But in *any* model some balance sheet adjustment would be necessary to adjust debt to its optimum level.

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(6) This assumes that there are no information asymmetries which could lead to dividend cuts being viewed as an adverse signal about company performance.
(7) The interest rate is greater than the growth rate in a dynamically efficient economy. While tax deductibility may mean that $(1-\tau)r_t^B < g$ for tax-paying companies, this is unlikely to be the case for tax-exhausted companies and those who face a significant premium on their borrowing costs.
(8) 40% of quoted non-financial companies did not pay a dividend in 2002, the binding dividends constraint for these firms implies that they would have to issue new equity or cut investment to adjust their balance sheets.

3. Long-run equilibrium capital gearing

The 'trade-off' theory of corporate capital structure described in Section 2 implies that firms trade off the advantages of holding debt against the expected costs of financial distress. In this section, we empirically test this theory at the aggregate level for the United Kingdom. Our analysis of the benefits of debt is limited to the tax advantages, since the effects of asymmetric information, agency costs and control rights cannot easily be quantified. By not modelling these factors we are implicitly assuming that their effect does not change over time. The expected costs of financial distress can be broken down into the probability of suffering distress and the costs incurred in the event of distress. We use a measure of bankruptcy risk to proxy the probability of suffering distress, and by not including a measure of costs in the event of distress we are implicitly assuming that these costs are constant over time. The measures of the tax gains from gearing and bankruptcy risk are described below.

The tax gains to gearing

On the basis of **(5)**, we define the tax gains to corporate gearing (TGG) as:

$$\text{TGG}_{\text{t}} = \sum_i w_{it} \left(\frac{(1-\tau_{it}^m)}{(1-g_{it}^m)} r_t - (1-\tau_{it}) r_t - \frac{g_{it}^m}{(1-g_{it}^m)} \pi^*{}_t \, d_t \right), \qquad \textbf{(11)}$$

for i = individuals and pension funds, where w_{it} is the share of total equity held by i, π^* is the expected one-period inflation rate, and d is a dummy variable for indexation of capital gains tax base (equals 1 from 1982 Q2 onwards). This expression differs from that shown in equation **(5)** in three ways. First, the tax gains from gearing are weighted by the equity holdings of individuals and pension funds to allow for the fact that pension funds do not pay income tax or capital gains tax.(9) Second, we augment **(5)** with an additional term which allows for the indexation of the capital gains tax base from 1982. Third, we measure the tax gains to gearing at the ruling interest rate rather than the marginal rate paid by the firm. This then captures the gains to gearing of a firm without debt. Details about the data we use to construct the tax gains from gearing variable can be found in Appendix 1.

Chart 1 shows our estimate of the tax gains to gearing since 1970. This is a relatively volatile series, but it is clear that there were substantial increases in the tax benefits to corporate debt in the early 1970s as corporation tax rates rose substantially.(10) The tax deductibility of interest from corporate profits for tax purposes meant that average shareholders could have been made better off by companies borrowing and the shareholders investing the proceeds in the money markets. Corporate gearing became less valuable through the 1980s as corporation tax rates fell. During the 1990s the tax benefits of debt were relatively constant at historically low levels, especially since the mid-1990s. At the end of the sample, the tax advantage to corporate borrowing is very slight.

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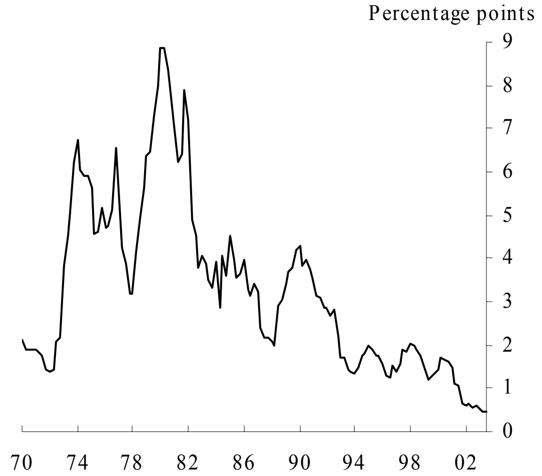
(9) It is not absolutely clear in theory how to treat different classes of investors. Auerbach and King (1983) show that weighting is appropriate under conditions of uncertainty.

(10) See Chart 9 in Appendix 1 for more details on these tax changes.

Chart 1: Tax gains to gearing[11]

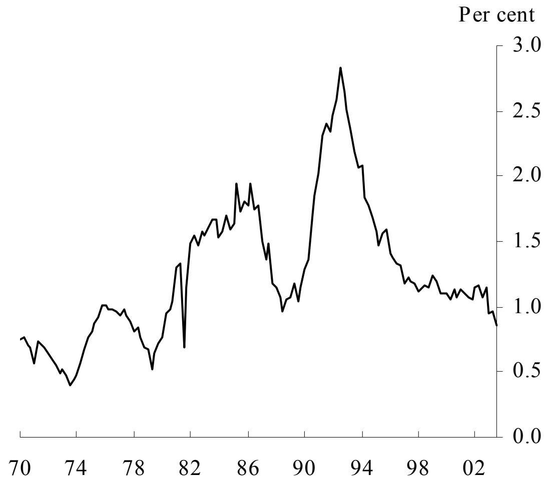


Measure of bankruptcy risk

Our measure of bankruptcy risk is the annualised corporate liquidations rate: the number of firms going into liquidation as a percentage of the stock of active companies. Firms may still suffer financial distress without formally entering liquidation, but this measure is likely to be highly correlated with the aggregate risk of default and is chosen to allow a sufficiently long run of data. In our debt equation we include a lag of the corporate liquidations rate, which implies the expected probability of bankruptcy in period *t* is equivalent to the observed probability of failure in *t*-1.

Chart 2 shows the corporate liquidations rate from 1970. It implies the probability of bankruptcy was low in the first half of the 1970s, after when it broadly increased until the mid-1980s. There was a fall in the corporate liquidations rate in the late 1980s, followed by the peak in the probability of bankruptcy during the 1990s recession, since when it has fallen consistently.

Chart 2: Annualised corporate liquidations rate



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[11] Tax gains from gearing are multiplied by 400 in the chart and can therefore be interpreted in terms of the annualised rate at which firms can borrow.

Equilibrium gearing

We examine the empirical relevance of the tax gains to gearing and measure of bankruptcy risk by testing their significance in a dynamic relationship for the gearing of private non-financial companies (PNFCs).(12) The relationship is estimated using data covering a 34-year period, and is reported in Table A. The equation is estimated in error correction form with the lagged level of the log of capital gearing at market value on the right-hand side; it is not assumed that net debt adjusts instantaneously to shocks to market value so separate terms for changes in these variables are included with the first difference of the log of net debt as the dependent variable.(13)(14)

Table A: Net debt equation

Dependent variable: $\Delta\ln(NDEBT_t)$ Estimation period: 1970 Q1 to 2003 Q3			
	Coefficient	T-ratio	P-value
Constant	0.2532	4.66	0.00
$\ln(CGEAR_{t-1})$	-0.0783	-4.38	0.00
$\Delta\ln(MV_t)$	0.0727	1.50	0.14
$\Delta\ln(MV_{t-1})$	-0.1770	-3.78	0.00
TGG_t	2.0845	2.30	0.02
LQR_t	-0.0144	-1.69	0.09
$Q1_t$	0.0352	3.37	0.00
$1981Q2_t$	-0.1753	-3.57	0.00
$1987Q1_t$	0.1372	2.74	0.01
$1990Q1_t$	0.2007	4.10	0.00
R^2	0.4758		
Standard error	0.0481		
LM serial correlation: F(4,121)	0.3718		0.83
RESET: F(1,124)	3.5709		0.06
Normality: Chi^2 (2)	0.8908		0.64
Koenker heteroscedasticity: F(1,133)	0.5379		0.47

NDEBT is net debt of PNFCs, MV is the market valuation of PNFCs, CGEAR is capital gearing of PNFCs at market value, TGG is the tax gains from gearing, LQR is the corporate liquidations rate, Q1 is a quarterly dummy for Q1, and 1981Q2, 1987Q1 and 1990Q1 are impulse dummies for those quarters. See Appendix 2 for more details on the definitions.

(12) Private non-financial companies includes both firms who are quoted on the stock market and those who are not.
(13) Net debt in the capital gearing calculation is defined as the sum of bank and bond debt minus liquid asset holdings. The market valuation is defined as net financial liabilities, which is an estimate of physical assets. A slightly wider definition of corporate gearing was reported in the December 2003 *Financial Stability Review*. This includes finance leasing and loans from institutions other than banks in the measure of debt and adds UK-resident financial assets to the market value calculation. The results reported are robust to this alternative measure of gearing at market value, but they are not robust to using measures of capital gearing at replacement cost. The market value definition is preferred since it is quicker to respond to market developments and because the capital stock is notoriously difficult to measure.
(14) We include three impulse dummy variables to coincide with the three largest outliners, without these the errors are not normally distributed. The 1990 Q1 dummy is related to a problem in the data: bonds issued by UK residents are recorded as zero in (and before) 1989 Q4, and £41 billion in 1990 Q1. To correct for this we splice net debt with data from Young (1993) at 1990 Q1 using a measure of debt based on discontinued ONS series. The 1981 Q2 dummy coincides with a 15% fall in net debt on the quarter; there is a 25% rise in 1987 Q1 and a 31% rise in 1990 Q1.

The tax gains to gearing variable is estimated to have a positive effect on corporate debt that is statistically significant at the 5% level.(15) This finding is consistent with Young (1996) who reports a similar specification for the same type of model, but using data only up to 1991. The specification of this equation is therefore robust to the addition of twelve more years of data, and the coefficients on the key variables have remained significant with the same signs. The inclusion of the lagged corporate liquidations rate as a measure of bankruptcy cost is an extension to previous work. This variable has a negative relationship with net debt, which we find to be statistically significant at the 10% level.

The finding of a positive relationship between debt and the tax advantages of gearing and the negative relationship between debt and the risk of bankruptcy provides empirical support for the 'trade-off' theory outlined in Section 2. The coefficient on corporate liquidations rate variable only being significant at the 10% level could be explained by the fact that this variable does not fully represent the expected costs of financial distress (which the 'trade-off' theory implies is used in determining the optimal capital structure) because it assumes the costs incurred in the event of distress are constant over time.

Much of the variation in debt can be explained in terms of shocks to corporate valuations, the tax gains from gearing, bankruptcy risk and the pattern of adjustment to them. Charts 10, 11 and 12 in the appendix show the fit of the equation. Of more interest is the long-run solution to the equation, which can be re-arranged to express capital gearing of PNFCs at market value as a function of a constant, the tax gains to gearing, bankruptcy risk and changes in net debt and the market value of PNFCs, see **(12)** below. This shows the level of gearing that would be chosen at each date if adjustment to all the determinants of gearing were complete, and it can be interpreted as a long-run equilibrium level of gearing that firms would like to adjust to (ECGEAR). By setting the dynamic terms to imply constant 2.5% quarterly growth rates in net debt and the market valuation of PNFCs, approximately in line with historical growth, we can write implied equilibrium capital gearing as a function of the tax gains from gearing, bankruptcy risk and a constant **(13)**.(16)

$$\ln(ECGEAR) = 3.23 - 12.76\Delta\ln(NDEBT) - 1.33\Delta\ln(MV) + 26.61TGG - 0.18LQR \qquad \textbf{(12)}$$
$$\ln(ECGEAR) = 2.88 + 26.61TGG - 0.18LQR \qquad \textbf{(13)}$$
$$ECGEAR = EXP(2.88 + 26.61TGG - 0.18LQR) \qquad \textbf{(14)}$$

The long-run solution shows that an increase in the tax gains to gearing from 3 to 4 percentage points, with the corporate liquidations rate evaluated at its average of 1.25%, would raise implied long-run equilibrium capital gearing at market value from 17.3% to 18.4%. An increase in the annualised corporate liquidations rate from 1% to 1.5%, with the tax gains from gearing evaluated at its average of 3.3% will reduce implied equilibrium gearing from 18.4% to 16.8%.

(15) We use the main rate of corporation tax and the basic rate of income tax in our calculation of the tax gains to corporate gearing. The finding that the tax gains to gearing are significant in the net debt equation still holds if we use effective tax rates in this calculation instead.
(16) 2.5% quarterly growth is close to the historical average growth rate for both of these series. It also implies that capital gearing at market value is stable in the long run. The value we choose for this is not important when testing whether the balance sheet disequilibrium term is significant in equations for dividends, net equity finance and investment. Any change in this value should only be reflected in a change in the constant in our equations.

The difference between the current level of gearing and the implied equilibrium level (CGEAREX) is interpreted as a measure of disequilibrium in company balance sheets **(15)**:

$$CGEAREX_t = CGEAR_t - ECGEAR_t \quad \textbf{(15)}$$
$$CGEAREX_t = CGEAR_t - EXP(2.88 + 26.61TGG_t - 0.18LQR_t) \quad \textbf{(16)}$$

Chart 3 compares the actual level of capital gearing at market value with the long-run implied equilibrium level of gearing from our model. Chart 4 shows the difference between these two series; our measure of balance sheet disequilibrium. According to these estimates, the desired level of capital gearing at market value has varied substantially between 12% to 28% since 1970. Most of the variation occurred during the 1970s and early 1980s; the desired level of gearing peaked in 1980. After this peak the long-run equilibrium level of gearing fell for most of the 1980s as corporation tax rates generally fell, except for a small increase at the end of that decade. The sharp increase in the probability of bankruptcy associated with the early 1990s' recession implied a further fall in the equilibrium level of gearing. There has been very little variation in the desired long-run level of gearing since the 1990s. The estimated current level is approximately 16%.

Chart 3: Actual and implied PNFC capital gearing at market value

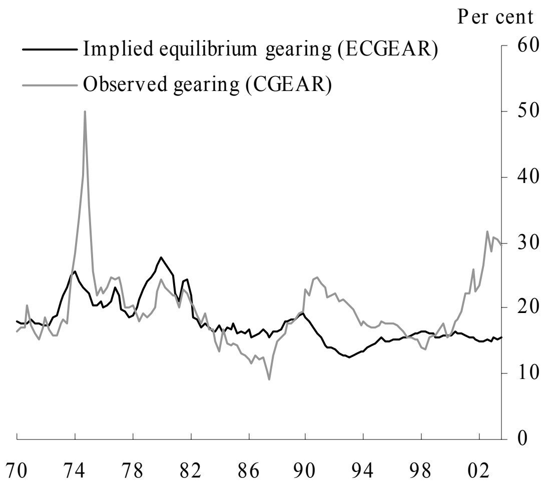
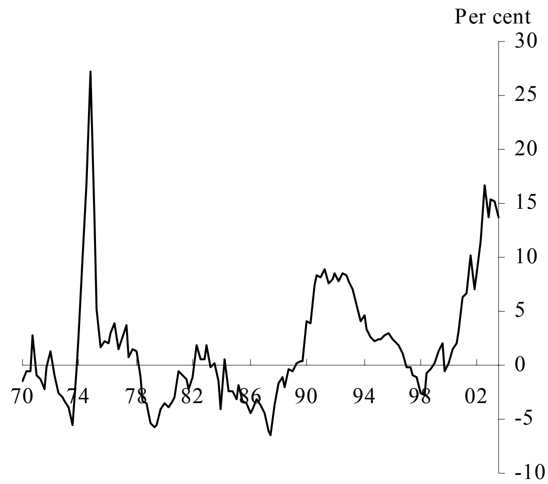


Chart 4: Difference between actual and implied equilibrium gearing



Disequilibrium gearing

The actual level of gearing can move away from equilibrium in response to the various shocks that companies face. Aside from temporary changes in factors affecting desired gearing, possible shocks include the arrival of investment or merger and acquisition opportunities as well as adverse cash-flow shocks. Companies may allow borrowing to rise in the short term in each case with the intention of reducing it in the longer term as, for example, investment opportunities pay off. There have been four main episodes in the past 30 years when observed gearing has diverged significantly from our estimate of equilibrium gearing. The first of these was in 1974 when severe stock market weakness reduced the market value of companies relative to their net debt and raised measured gearing substantially relative to equilibrium. This disequilibrium was largely eliminated by a market recovery, and continued growth in equity prices allowed gearing to fall below equilibrium in the late 1970s. The second period of disequilibrium was in the mid-1980s when corporate gearing fell below what was optimal. This was more than reversed by a sharp increase in corporate debt in the late 1980s and early 1990s. According to these estimates, companies spent most of the 1990s gradually adjusting their balance sheets back to equilibrium. The fourth period of disequilibrium is the current one, where the increase in indebtedness since 1998 combined with falls in the market valuation of the corporate sector since the beginning of 2000, has seen capital gearing at market value increase to a position well above its estimated long-run optimal level.

As discussed earlier, and in Benito and Young (2002), there are a number of ways in which companies can adjust their balance sheet when gearing moves away from its desired level. In the remainder of the paper we empirically test whether balance sheet adjustment motivated by the aim to move towards the equilibrium level of indebtedness takes place through adjustments to dividends, net equity finance and investment. This is not exhaustive, as adjustment can also take place through other channels such as inventories, wages and employment (Nickell and Nicolitsas (1999)).

4. Dividends and adjustment

The 'new view' of corporate financial behaviour on which the theoretical section of this paper is based would suggest that the main means of balance sheet adjustment is through changes in dividend payments. Indeed, according to the strict version of this approach, dividends act as a residual item, adjusting after other corporate real and financial decisions have been taken. In this strict sense, dividends would be expected to adjust instantaneously to balance sheet disequilibria. In practice, dividends may be sticky because of information asymmetries, agency costs and behavioural issues. The speed of adjustment is an empirical question, and while we would expect there to be a negative relationship between dividends and our measure of balance sheet disequilibrium, it is unlikely to be instantaneous. The existence of such a relationship would support the 'trade-off' theory and the notion of adjustment to an optimal capital structure. If there were no relationship, this would be evidence in favour of the 'pecking order' theory where there is no equilibrium level of gearing to which firms try and adjust. To examine this issue, we estimate the empirical relationship between dividends and balance sheet disequilibrium in a dynamic error correction equation. The results are reported in Table B.[17]

We find a negative coefficient on the balance sheet disequilibrium variable that is significantly different from zero at the 1% level. As capital gearing rises above the long-run implied equilibrium level firms adjust their balance sheets by reducing their dividend payments, as predicted by our model. A 1 percentage point increase in the gap between actual and desired capital gearing would reduce the level of dividends in the next period by 1.8%, holding all other factors constant. There is evidence of lagged adjustment consistent with the view that companies smooth dividends over time. If alternative lags of the balance sheet disequilibrium term are used in

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(17) We estimate this equation from 1988 Q2 onwards because of particular volatility in dividends in the preceding two quarters, which distorts the results. Dividends fell by 24% in 1987 Q4, before rising by 65% in 1988 Q1. Data on the dividends series we use is only available from 1987.

this equation the coefficient on this variable up to the seventh lag is still significant at the 5% level.[18] This suggests that the process of balance sheet adjustment is a gradual one.

Table B: Dividends equation

Dependent variable: $\Delta\ln(DIV_t)$ Estimation period: 1988 Q2 to 2003 Q3			
	Coefficient	T-ratio	P-value
Constant	-4.0176	-3.68	0.00
$\ln(DIV_{t-1})$	-0.6708	-6.86	0.00
$\ln(LIQAS_{t-1})$	0.8658	6.26	0.00
$CGEAREX_{t-1}$	-0.0184	-3.81	0.00
$DTAX_t$	-0.2055	-2.73	0.01
$DTAX2_{t+1}$	-0.6955	-5.32	0.00
$DTAX2_t$	1.0520	6.21	0.00
$DTAX2_{t-1}$	-0.3905	-3.11	0.00
R^2	0.7082		
Standard error	0.1160		
LM serial correlation: F(4,50)	0.4991		0.74
RESET: F(1,53)	0.0423		0.84
Normality: Chi^2 (2)	2.2548		0.32
Koenker heteroscedasticity: F(1,60)	0.9528		0.34

DIV is dividends paid by PNFCs, LIQAS is liquid assets held by PNFCs, CGEAREX is the measure of excess capital gearing derived in Section 3, DTAX is a dummy which takes the value of one from 1997 Q3 onwards and DTAX2 is a dummy which takes the values of one from 1999 Q2 onwards. See Appendix 3 for further information on these variable definitions.

The presence of a lagged level dividends term incorporates a long-run solution into the model, shown in equation **(17)**. In a long-run steady state, a 1 percentage point increase in the distance between actual and implied equilibrium gearing will reduce dividends by 2.7%, *ceteris paribus*. This is consistent with the company-level findings of Benito and Young (2002) who estimate a long-run elasticity of dividend payments with respect to debt of 2.2%.

$$\ln(DIV) = -5.99 + 1.29\ln(LIQAS) - 0.31DTAX - 0.027CGEAREX \quad \textbf{(17)}$$

The equation also suggests a positive relationship between dividends and the amount of liquid assets PNFCs hold, which acts as the scale variable. When firms have surplus cash they increase the amount they return to shareholders by paying higher dividends. The long-run solution to this equation suggests that a 1% increase in liquid assets will increase dividends by 1.29%, although the overall effect depends on whether this moves the balance sheet away from equilibrium.

The remaining variables in the dividends equation are related to changes in the tax treatment of dividend payments which have taken place in recent years. In July 1997 tax credits on dividend

(18) The largest coefficient is associated with the first lag of the balance sheet disequilibrium term.

payments to pensions funds were abolished, which made retentions a more attractive source of investment finance, since pension funds had less desire for dividends. We might therefore expect that firms would pay lower dividends as a result of this tax change, which is captured here by a dummy variable that takes the value of one from 1997 Q3 onwards (DTAX). The coefficient on this variable is negative and significantly different from zero.(19) It is estimated that in the long run the removal of tax relief on dividend payments to pension funds has reduced dividends by 31% relative to what they would otherwise have been.

This is a larger effect than might be expected on the basis of the evidence of Benito and Young (2001) who found little reason to link the recent increase in divided omission by companies to the 1997 tax reform. This would suggest that the effect of the tax reform is coming through lower dividend payments by dividend-paying companies than by outright omission. To the extent that dividends are being restrained by relatively large companies who are responding to the change in tax incentives by retaining more profits, this is consistent with the theoretical model set out in Section 2.

We also control for the abolition of advance corporation tax in April 1999. Before April 1999 when a firm paid a dividend they were liable to pay advance corporation tax on the dividend. This implies that it became more attractive to pay dividends following this tax change. The dummy variable DTAX2 takes the value of one from 1999 Q2 onwards. The coefficient on this variable is positive indicating that dividends increased significantly in 1999 Q2. However the coefficient on DTAX2 led by one period is negative implying that dividends which would have otherwise been paid in 1999 Q1 were held back until Q2 so they were no longer liable for advance corporation tax. There is also a negative coefficient on the one-period lag of DTAX2. We could not reject the hypothesis that the net effect of the abolition of advance corporation tax was zero.(20) Our model therefore suggests that the abolition of advance corporation tax has had no long-run effect on dividends.

5. Net equity finance and adjustment

An alternative way for firms to adjust their balance sheets is by issuing equity. When a firm has excessive debt it can issue more equity (assuming market conditions are conducive to equity finance) and use the proceeds to pay off debt, moving closer towards the equilibrium level of gearing. If this is important empirically we should expect to see a positive relationship between net equity finance raised and the distance between actual capital gearing and its equilibrium

(19) In the course of our estimation we allowed for short-run volatility in dividends for the abolition of tax credits on dividends paid to pension funds in a similar way to as in the abolition of advance corporation tax, but we found that these effects were not significant.
(20) Testing the hypothesis that the sum of the coefficients on the DTAX2 variables is equal to zero using a Wald test produces a p-value of 0.6, indicating that we can accept the null hypothesis that the coefficients do sum to zero at any reasonable significance level.

long-run level. We test this by estimating an equation for net equity finance, which we scale by the market valuation of PNFCs. The results are reported below in Table C.[21]

Table C: Net equity finance equation

Dependent variable: $\Delta NEFMV_t$
Estimation period: 1987 Q2 to 2003 Q2

	Coefficient	T-ratio	P-value
Constant	0.0199	1.71	0.09
$NEFMV_{t-1}$	-0.9288	-9.90	0.00
$GOSY_{t-1}$	-0.0011	-2.15	0.04
$\Delta\ln(EQP_{t-1})$	0.0193	2.63	0.01
$\Delta\ln(EQP_{t-2})$	0.0227	3.11	0.00
$CGEAREX_{t-1}$	0.0003	2.41	0.02
$2000Q3_t$	0.0184	4.94	0.00
$2002Q3_t$	-0.0229	-6.01	0.00
R^2	0.7202		
Standard error	0.0037		
LM serial correlation: F(4,53)	0.8601		0.49
RESET: F(1,56)	0.2162		0.64
Normality: Chi^2 (2)	1.2592		0.53
Koenker heteroscedasticity: F(1,63)	1.0957		0.30

NEFMV is the ratio of net equity finance to the market value of PNFCs, GOSY is the gross operating surplus of PNFCs as a percentage of GDP, EQP is equity prices, CGEAREX is excess capital gearing, and 2000Q3 and 2002Q3 are impulse dummies for those respective quarters. See Appendix 4 for more details on the definitions of these variables.

The coefficient on the balance sheet disequilibrium term is positive and significant at the 5% level. This supports the hypothesis that PNFCs increase the amount of net equity finance raised when their current level of gearing is above its equilibrium level to enable them to move closer to this equilibrium level of capital gearing. A 1 percentage point increase in the difference between observed capital gearing at market value and the long-run desired level increases net equity finance raised by PNFCs as a percentage of their market value in the following period by 0.033 percentage points, *ceteris paribus*. This is equivalent to around £0.4 billion per quarter given the current market value of the PNFC sector. This evidence is consistent with Benito and Young (2002) who find in a random effects probit model that debt is a significant determinant of the propensity of a company to issue new equity.

This model of net equity finance includes a lag of the level of the ratio of net equity finance to market value suggesting some persistence in net equity finance raised. If we include different lags of the balance sheet disequilibrium term in this model in place of the first lag these are significant at the 5% level up to the 13th lag. As in the dividends equation, this suggests that balance sheet

[21] We only exclude 2003 Q3 from our estimation because net equity finance raised fell by over £10 billion in 2003 Q3, which would be a significant outliner if this quarter was included in estimation period.

adjustment is a long-term process. We also find that changes in equity prices are positively related, and the profit share of GDP is negatively related to changes in the ratio of net equity finance to the market value of PNFCs. This implies that when markets are performing well more firms want to raise more equity finance, or it becomes easier for them to raise equity finance. It also suggests firms raise less equity finance when profits are high, probably because they are able to use their additional retained profits to finance expenditure which would otherwise be financed by raising equity finance. We also include two impulse dummy variables, for 2000 Q3 and 2002 Q3 to ensure that the residuals are normally distributed.[22]

In the long-run steady state a 1 percentage point increase in the balance sheet disequilibrium term would raise the net equity finance raised as a percentage of market value by 0.035 percentage points. This is shown in the long-run steady-state solution, equation **(20)**.

$$NEFMV = 0.021 - 0.0012GOSY + 0.00035CGEAREX \qquad \textbf{(20)}$$

Similarly, a 1 percentage point increase in the gross operating surplus of PNFCs as a percentage of GDP reduces net equity finance raised as a percentage of market value by 0.12 percentage points in the long-run steady state.

6. Investment and adjustment

The earlier theoretical section discussed the circumstances under which firms would use capital investment as a tool of balance sheet adjustment. It is argued there that capital investment need not be affected when companies are aiming to adjust their balance sheets. But capital investment might be affected when companies are unable to carry out further adjustment through financial polices to vary their debt.[23] In particular when capital gearing is above its long-run implied equilibrium level and firms are unable to adjust it by cutting dividends further, then they might reduce their investment and use the money that would have otherwise been invested to pay down debt and reduce gearing towards the desired level. This argument suggests that there might be a negative relationship between investment and the difference between capital gearing and its equilibrium level, although there may also be circumstances when there is no effect. Benito and Young (2002) find that capital investment responds to flow rather than stock measures of financial pressure, consistent with this argument. Nevertheless, the question of the aggregate impact of balance pressures on investment is essentially an empirical question to which we now turn.

We initially test these hypotheses by estimating an equation for business sector investment based on that used in the Bank of England's medium-term macroeconomic model (MTMM). We augment the MTMM equation by adding a balance sheet disequilibrium term, and we extend the sample period slightly. The MTMM specification contains lags of the change in business investment, a lag of the change in GDP and an error correction term that is derived from the

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[22] Net equity finance (see Chart 17 in Appendix 4) is a volatile series, particularly since 2000.
[23] A similar point is made by Morck, Schleifer and Vishny (1990) and Stein (1996) who argue that when shares are mispriced, firms can engage in financial arbitrage without changing their capital investment.

Cobb-Douglas production function. This initial equation is reported in Table E in Appendix 5. We then remove the first two lags of the dependent variable to improve the efficiency of the estimation as these variables are highly insignificant, and report the results in Table D below.

Table D: Business investment equation

Dependent variable: $\Delta\ln(IBUS_t)$
Estimation period: 1983 Q2 to 2003 Q3

	Coefficient	T-ratio	P-value
Constant	-0.0018	-0.32	0.75
$\Delta\ln(IBUS_{t-3})$	0.1869	2.20	0.03
$\Delta\ln(IBUS_{t-4})$	0.2305	2.71	0.01
$\Delta\ln(GDP_{t-1})$	1.6801	3.07	0.00
$\ln(IBUS_{t-1}) - \ln(KNH_{t-2}) - \Delta\ln(GDP_{t-1}) + 5.583 - 9.441(\ln(BETA_{t-1}) - \Delta\ln(GDP_{t-1})) + 0.673(\ln(KNH_{t-2}) - \ln(GDP_{t-2}) + \ln(WACC_{t-1}))$	-0.0853	-2.66	0.01
$CGEAREX_{t-2}$	-0.0007	-1.07	0.29
$1985Q1_t$	0.0797	3.25	0.00
$1985Q2_t$	-0.1562	-6.20	0.00
R^2	0.5519		
Standard error	0.0240		
LM serial correlation: $F(4,70)$	0.7958		0.53
RESET: $F(1,73)$	1.3137		0.26
Normality: Chi^2 (2)	0.6190		0.73
Koenker heteroscedasticity: $F(1,80)$	1.7521		0.19

IBUS is business investment, GDP is GDP, KNH is the non-residential capital stock, BETA is one minus the business sector depreciation rate, WACC is the weighted average cost of debt and equity, CGEAREX is our measure of balance sheet disequilibrium, and 1985Q1 and 1985Q2 are impulse dummies for their respective quarters. See Appendix 5 for further information on these variables.

The coefficient on the balance sheet disequilibrium term in this equation is negative, but it is insignificantly different from zero, with a p-value of approximately 0.3.[(24)] At face value, the estimated coefficient, while statistically insignificant, suggests that a 1 percentage point increase in capital gearing at market value above the implied equilibrium level reduces investment two periods forward by 0.07 percentage points. In the long run, shown in **(21)**, a 1 percentage point increase in capital gearing above the desired level would reduce investment by 0.9%, all other factors held constant.

$$\ln(IBUS) = -5.60 + 0.33\ln(KNH) + 0.67\ln(GDP) + 9.44\ln(BETA) - 0.67\ln(WACC) - 0.009CGEAREX \qquad \textbf{(21)}$$

[(24)] We report the model with the second lag of the balance sheet disequilibrium term as this gives slightly larger t-ratios than the first.

If the sample period over which the business investment equation is estimated is restricted there is stronger evidence that our measure of balance sheet disequilibrium does determine investment as the coefficient on this variable is significant at the 5% level. This result is reported in Table F in Appendix 5. However, the less convincing result from the equation estimated over the full period for which data is available leads us to conclude there is only very weak evidence that business investment is inversely related to our measure of balance sheet adjustment. The evidence that our measure of balance sheet disequilibrium affects investment is much less robust than that with respect to dividends and net equity finance. This can be reconciled by the fact that the dividends constraint seldom binds in practice and therefore investment rarely needs to be reduced by firms wanting to adjust their balance sheets and is consistent with Benito and Young (2002).[25]

7. Simulation properties

One of the motivations for testing whether or not balance sheet disequilibrium is a significant determinant of dividends, net equity finance and investment is to incorporate the resulting equations into a macroeconomic framework that may be used in forecasting and policy analysis.[26] In this section of the paper we examine the properties of a model incorporating the new equations and show how it responds to shocks. The two shocks considered are a demand shock and an equity price shock. The demand shock reduces both world and domestic demand such that UK GDP is approximately 2% lower than base after three years. The equity price shock is an unanticipated 35% fall in both world and UK equity prices, which could occur as a result of a revision to expectations about corporate earnings. The equity price shock is similar to that described in Hoggarth and Whitley (2003) which was used as part of the International Monetary Fund's recent Financial Sector Assessment Programme.

We use the Bank's MTMM and a modified version of the corporate and household sector extension described in Benito, Whitley and Young (2001) as a basis for these simulations.[27][28] Interest rates are assumed to be fixed in response to the shocks described here. We assume that the tax gains to gearing are constant at their last observation, consistent with the assumption of constant interest rates and the fact that there have been no pre-announced tax changes at the time of writing that would affect this term. The corporate liquidations rate is projected using the

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(25) Interacting our balance sheet disequilibrium term with estimates of a binding dividend constraint in aggregate in the investment equation does not substantially improve the explanatory power of this variable.
(26) Equations of the type reported here have been used in the Bank for this purpose since late 2002.
(27) For an explanation of the MTMM see Bank of England (2000), for more information on the corporate sector extension used see Benito, Whitley and Young (2001). The version of the corporate sector model extension used here has been altered from the version reported in Benito, Whitley and Young (2001). The main difference which affects the results reported here is that distributions are now modelled as dividends plus distributions other than dividends, whereas previously only total distributions were modelled. An equation for liquid assets (which is necessary to incorporate our dividends equation) has also been introduced which makes liquid assets a function of gross disposable income. A revised equation for corporate liquidations is also used, in which income gearing and the economic cycle are the most important determinants of corporate liquidations.
(28) The Bank has recently developed a new macroeconomic model on which the *Inflation Report* forecast is now based. This new model is more theoretically based than its predecessor, the MTMM, which was essentially a large vector error correction model. However, at the time of writing we are not able to incorporate equations from this paper into the new model to run illustrative simulations. We therefore rely on the MTMM for this purpose.

equation in the corporate sector extension and subsequent changes in liquidations are allowed to feedback to changes in equilibrium gearing. The changes in equilibrium gearing are small, less than 1 percentage point in all simulations, and we therefore focus only on how firms adjust to equilibrium following a shock rather than how the equilibrium changes.[29]

We compare the response of three versions of our macroeconomic model to the shocks. The first contains the three equations reported in the main body of this paper for dividends, net equity finance and business investment, all of which have a balance sheet adjustment mechanism incorporated.[30] The second uses the equations with the balance sheet adjustment term for dividends and net equity finance, and the current MTMM equation for business investment (which does not allow any adjustment to take place through the investment channel). The third version allows no adjustment to take place. In this case the equations for dividends and net equity finance are the specifications reported above re-estimated without the balance sheet disequilibrium term, and the investment equation is the MTMM version.

Chart 5 shows the response of capital gearing at market value to the shocks in the version of the model with all forms of balance sheet adjustment (solid line), with adjustment through dividends and net equity finance only (broken line) and without balance sheet adjustment (dotted line). After both shocks occur there is immediately a significant increase in capital gearing at market value in all simulations. In the case of the equity price shock this arises because the fall in equity prices reduces the market valuation of the corporate sector, thereby driving up gearing. In the case of the world demand shock, gearing rises, both because corporate profitability is adversely affected, thereby necessitating more debt finance in the short run, and because equity prices fall in response to the occurrence of the demand shock.

The initial response to the shocks is similar in all three versions of the model, but in the case without a balance sheet adjustment mechanism capital gearing at market value does not make any significant move back towards base in the four years following either shock. In the versions of the model that incorporate the equations with the balance sheet adjustment terms there is an adjustment in gearing back towards base, although the process is slower if no adjustment is allowed to take place via investment.

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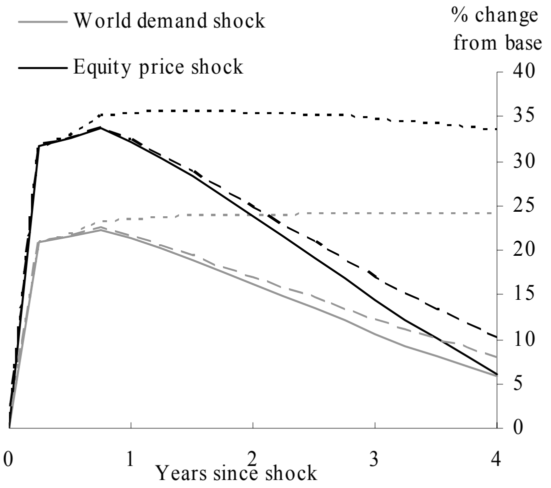
[29] A macroeconomic slowdown will initially increase liquidations, but if adjustment takes place, debt will be reduced which will reduce income gearing and have a negative impact on liquidations. The change in liquidations and therefore the change in equilibrium gearing will be determined by the relative size of these effects, which depends on the nature of the shock and the amount of adjustment that is allowed to take place.
[30] The equation reported in Table D is used for business investment.

Chart 5: Response of capital gearing at market value to shocks[(a)]



(a) Solid line represents the response using the equations that incorporate full balance sheet adjustment; the broken line does not allow investment to adjust. The dotted line shows the response using equations without the balance sheet adjustment term.

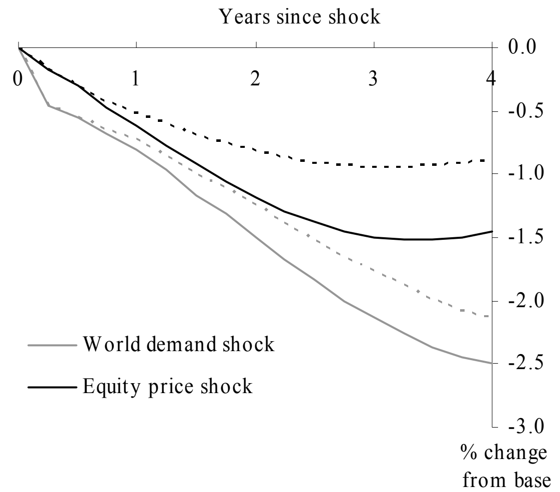
The adjustment of capital gearing takes place through the response of the individual equations for dividends, net equity finance and investment where appropriate. The process of adjustment is protracted because the flows of dividends, net equity finance and investment are small in relation to the stock of debt. To illustrate this point, in 2003 Q3, the flow of dividends paid by PNFCs accounted for 5.4% of net debt; the corresponding figure for business investment was 7.5%. Lower dividends and investment resulting from the above optimal level of gearing improve the financial balance of the corporate sector, and that enables firms to finance more expenditure internally, hence they need to borrow less and they are able to reduce debt and therefore gearing. The increase in net equity finance means that less capital needs to be raised from borrowing, again this allows firms to reduce their debt.

The individual responses of dividends, net equity finance, investment and net debt are shown in Charts 22 to 25 in Appendix 6. The response of dividends and investment is negative in all periods following the shocks, but the size of the negative contribution is much larger when companies are attempting to adjust their balance sheets. Immediately following the shocks less net equity finance is raised because of the positive relationship between equity prices and equity finance. However, in the longer run more equity finance is raised, partly because profitability is reduced following the shocks, and partly because of the balance sheet adjustment that takes place.[(31)] If no adjustment occurs through investment, the cuts in dividends are larger and slightly more equity finance is raised. The response of dividends to both shocks is relatively rapid, with a peak change within a year and then a return towards base as the balance sheet disequilibrium is gradually eliminated. The dynamic response of capital investment is much slower reflecting the long lags in the estimated equation. In both simulations, investment would have fallen in the absence of balance sheet adjustment because of the weakness in GDP.

[(31)] The latter of these two is only true in the model that allows for balance sheet adjustment.

The movement of capital gearing back towards base is more rapid in the case of the equity price shock than for the world demand shock. The size of the balance sheet adjustment effect is actually bigger for the equity price shock because the initial increase in gearing is larger. However, profitability is more adversely affected following the demand shock and therefore less profit is available to repay debt following the demand shock than after the equity price shock.[32] The profit effect dominates the larger balance sheet adjustment effect following the equity price shock, and this is why we see a more rapid adjustment towards base in the case of the equity price shock relative to the world demand shock. This is illustrated in Chart 6, which shows how GDP responds to the two shocks. The slowdown in GDP is greater when we allow for balance sheet adjustment because investment is weaker.

Chart 6: Response of GDP to shocks[(a)(b)]



(a) Solid line represents the response using the equations that incorporate full balance sheet adjustment. The dotted line shows the response using equations without the balance sheet adjustment term.
(b) The response with adjustment through dividends and equity issuance but not investment is not shown here because it is almost identical to the response with no adjustment. This is because there is no feedback from changes in dividends and equity issuance to GDP in the model.

8. Conclusion

This paper has a number of important results. First, at the aggregate level in the United Kingdom, companies appear to have target levels of gearing. This reinforces the findings of Benito and Young (2002) who found similar evidence at the firm level. Second, the gearing target appears to be responsive to both the tax advantages of debt and the risk of bankruptcy (a component of the expected costs of financial distress) in line with the ‘trade-off’ theory of corporate capital structure. The finding with respect to the tax advantages of debt reinforces the evidence of Young (1996) on an expanded data set. The evidence in relation to the probability of bankruptcy is a new result. Third, companies in aggregate vary dividends, new equity issues and, less clearly,

[32] GDP is one of the main determinants of corporate sector profitability in our macroeconometric model. The greater adverse effect on GDP in the demand shock explains why profitability is reduced by more in the former simulation.

investment so as to achieve their gearing targets. This is also consistent with Benito and Young who found evidence of adjustment in these variables at the firm level with the proviso that investment appeared to be more responsive to a flow measure of financial pressure than a stock measure of balance sheet disequilibrium.

The evidence also suggests that while companies may respond quickly to adjust their balance sheets, the actual process of adjustment is likely to be protracted simply because the flows of dividends and investment are small in relation to the stock of debt. As such, a large adjustment to a flow will have only a small effect on the stock in a particular quarter. It appears from the simulation results that adjustment to flows, especially dividends, occurs rapidly but that this needs to be sustained over a period of several years to bring balance sheets back to equilibrium.

Appendix 1: Calculation of the tax gains to gearing

Tax gains to gearing (TGG) are defined as:

$$\text{TGG}_t = \sum_i w_{it}\left(\frac{(1-\tau^m_{it})}{(1-g^m_{it})} r_t - (1-\tau_{it}) r_t - \frac{g^m_{it}}{(1-g^m_{it})} \pi^*_t \, d_t \right), \text{ for } i = \text{individuals and pension funds.}$$

w_i = equity held by i as a proportion of total holdings of individuals and pension funds
r = one-period nominal interest rate
τ^m = personal income tax rate
g^m = personal capital gains tax rate
τ = corporation tax rate
π^* = expected one-period inflation rate
d = dummy variable for indexation of capital gains tax base (= 1 from 1982 Q2 onwards)

Weight of pension funds in equity holdings

The proportion of pension funds equity holdings in the total holdings of individuals and pension funds is a complex calculation, which is detailed below. Individuals' equity holdings are defined as the equity holdings of individuals, unit trusts, investment trusts and other financial institutions. Pension funds' equity holdings are defined as the holdings of all tax-exempt holders of equity. These are pension funds, non-profit making bodies (charities) and the pension business of life assurance companies. The pension business of life assurance companies is assumed to be one quarter of their total equity holding in line with King and Fullerton (1984). The proportion of equity held excludes shares held by the rest of the world, since it is not possible to calculate the tax incentives for overseas investors.

The proportion of pension funds' equity holdings in the total holdings of individuals and pension funds is calculated using data for Q4 from the ONS *Share Ownership Report* in 1969, 1975, 1981, 1989-1994, and 1997-2002. Until 1988 Q4 data is taken from Young (1992) if data from the *Share Ownership Report* is unavailable.

Until 1987 quarterly observations are linearly interpolated. The ONS ratio of net equity of households in life insurance fund reserves and pension fund reserves as a proportion of total equity holdings is used to interpolate quarterly data from the actual Q4 data from 1988 onwards (ONS codes: NYZZ/NZBH). This data does not break down into pension fund and life insurance holdings, nor does it estimate equity held by insurance companies which is associated with their pension fund business. The ratio of the ONS measure to the observed share of pension funds' equity holdings from the *Share Ownership Report* or Young (1992) is taken for Q4 in each year. The ratio between the two Q4 observations is then linearly interpolated to generate a quarterly series (observed/ONS). The interpolated estimate of the proportion of pension funds' equity holdings in the total holdings of individuals and pension funds is then the ONS measure multiplied by the linearly interpolated ratio. From 2003 Q1 the ratio of the *Share Ownership Report* estimate to the ONS data is set exogenously at the 2002 Q4 level.

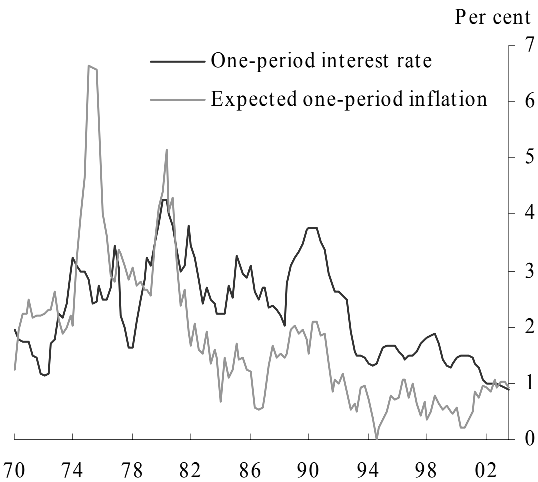
The proportion of equity held by individuals in the total holdings of individuals and pension funds is one minus the proportion held by pension funds.

Chart 7: Pension fund equity holdings as a proportion of total holdings of pension funds and persons

Macro variables

Variable	Data source
One-period nominal interest rate (r)	0.0025(ONS code: AMIH)
Price index (P)	ONS codes: CGCB/YBHH
One-period inflation rate (π)	$\pi_t = (P_t/P_{t-1}) - 1$
Expected one-period inflation rate (π^*)	$\pi^*_t = (\pi_t.\pi_{t-1}.\pi_{t-2}.\pi_{t-3})/4$

Chart 8: One-period *ex-post* expected inflation and nominal interest rate

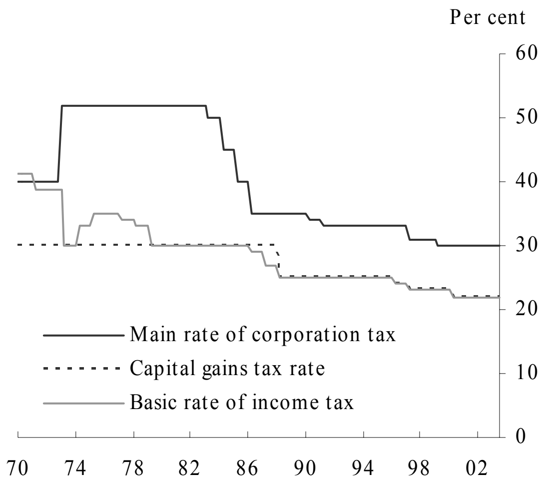


Tax rates

All data on the tax rates comes from the Inland Revenue.

Variable	Group	Data source
Corporation tax rate (τ)	-	Main rate of corporation tax
Personal income tax rate (τ^m)	Individuals	Basic rate of income tax
Personal income tax rate (τ^m)	Pension funds	Zero
Personal capital gains tax rate (g^m)	Individuals	Capital gains tax rate
Personal capital gains tax rate (g^m)	Pension funds	Zero
Indexation of capital gains tax dummy (d)	-	=1 from 1982 Q2 onwards

Chart 9: Tax rates



Appendix 2: Net debt equation

Variable	Data source
Net debt of PNFCs (NDEBT)	From 1990 Q1 ONS codes: NLBE + NLBI + NKZA – NKJZ Spliced at 1990 Q1 with data from Young (1993)
Market valuation of PNFCs (MV)	ONS code: – NYOT
PNFCs’ capital gearing at market value (CGEAR)	100.NDEBT/MV
Tax gains to gearing (TGG)	See Appendix 1
Annualised corporate liquidations rate	400*(ONS code AIHT)/(Number of active companies, source: DTI)

Chart 10: Net debt equation actual and fitted values

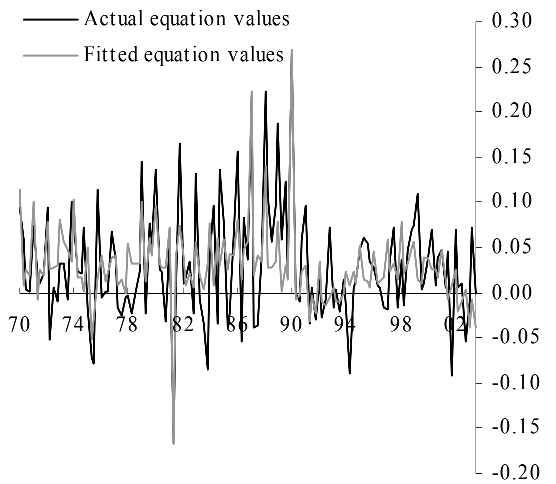


Chart 11: Net debt series actual and fitted values

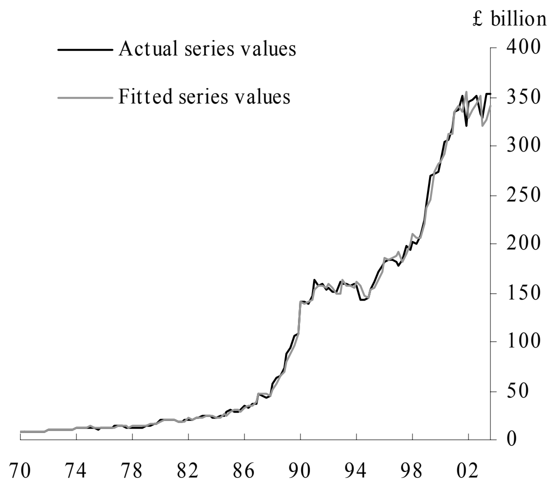
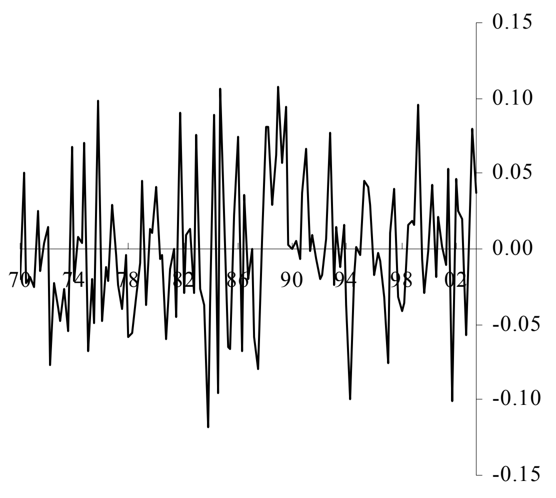


Chart 12: Net debt equation residuals



Appendix 3: Dividends equation

Variable	Data source
Dividends paid by PNFCs (DIV)	ONS code: RVFT
Liquid assets held by PNFCs (LIQAS)	ONS code: NKJZ
DTAX	Dummy variable, = 1 from 1997 Q3 onwards
DTAX2	Dummy variable, = 1 from 1999 Q2 onwards
Excess capital gearing of PNFCs at market value (CGEAREX)	Defined in equation **(16)**

Chart 13: Dividends equation actual and fitted values

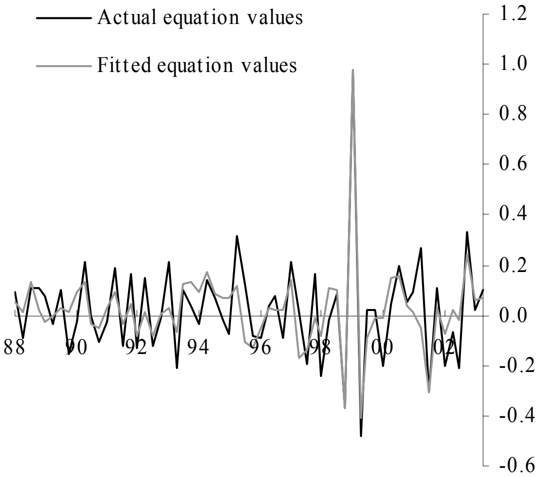


Chart 14: Dividends series actual and fitted values

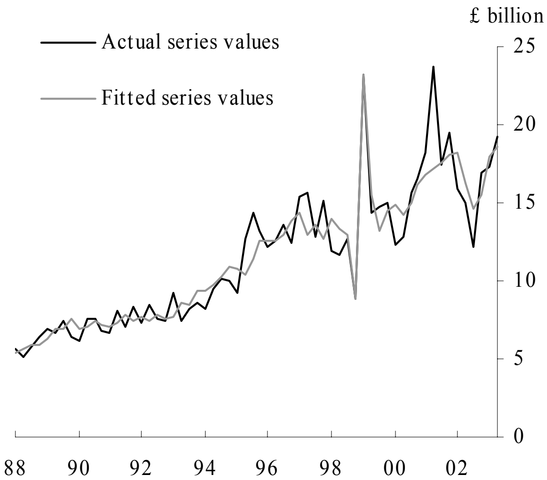
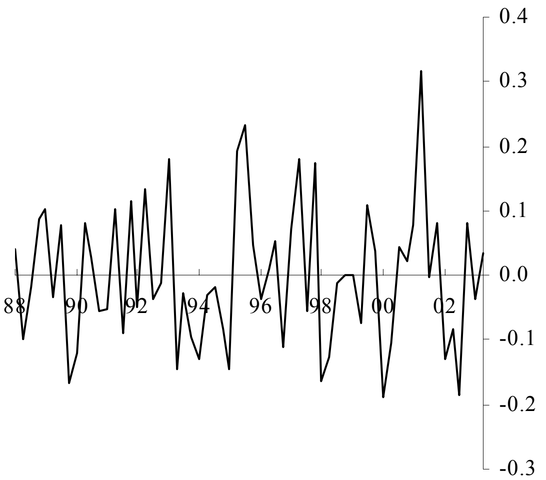


Chart 15: Dividends equation residuals



Appendix 4: Net equity finance equation

Variable	Data source
Net equity finance raised by PNFCs (NEF)	ONS codes: NEVL – NESH
Market valuation of PNFCs (MV)	ONS code: – NYOT
Ratio of net equity finance to market value of PNFCs (NEFMV)	NEF/MV
Gross operating surplus of PNFCs as a percentage of GDP (GOSY)	ONS codes: 100.(CAER/CGCB)
Equity prices (EQP)	FTSE All-Share index
Excess capital gearing of PNFCs at market value (CGEAREX)	Defined in equation **(16)**

Chart 16: Net equity finance equation actual and fitted values

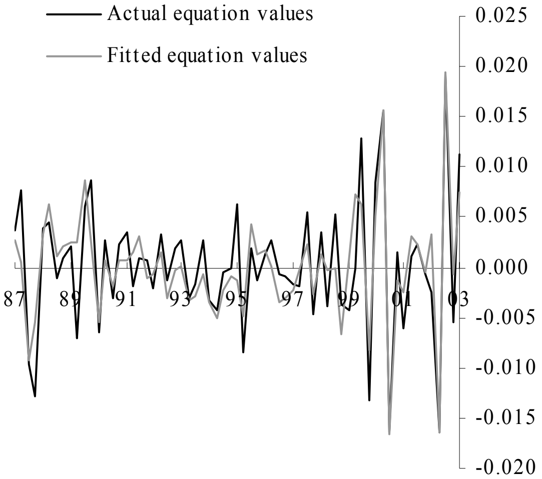


Chart 17: Net equity finance series actual and fitted values

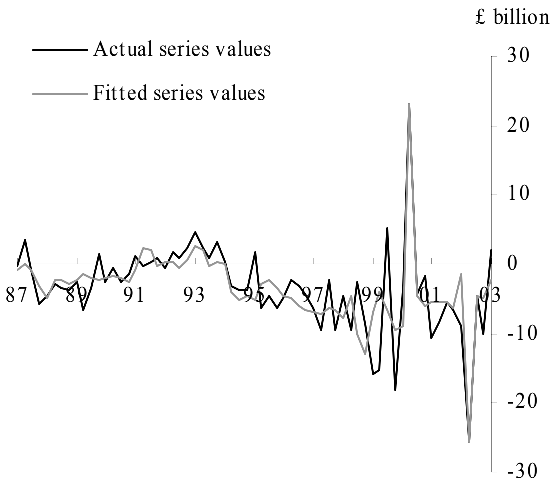
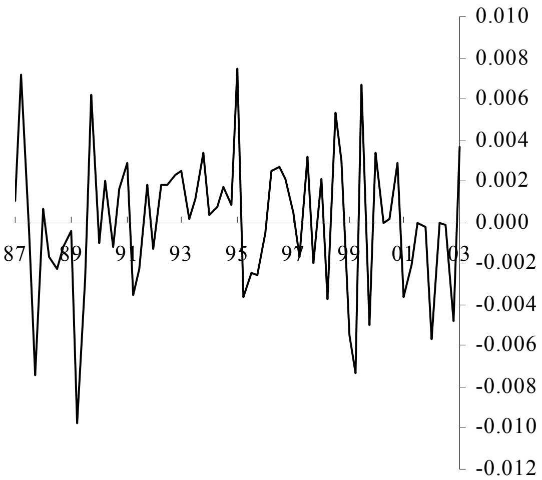


Chart 18: Net equity finance equation residuals



Appendix 5: Investment equations

Variable	Data source
Business investment (IBUS)	ONS code: NPEL
Gross domestic product (GDP)	ONS code: YBHH
Non-residential capital stock (KNH)	$BETANH_t$*KNH_{t-1} + (ONS codes: NPQT – DFEA) where BETANH is one minus the whole-economy capital stock of net housing and non-dwelling investment (BoE constructed index)
One minus business sector depreciation rate (BETA)	BoE constructed index
Weighted average cost of debt and equity (WACC)	BoE constructed index
Excess capital gearing of PNFCs at market value (CGEAREX)	Defined in equation **(16)**

Table E: Business investment equation with insignificant lags of dependent variable

Dependent variable: $\Delta\ln(IBUS_t)$ Estimation period: 1983 Q2 to 2003 Q3			
	Coefficient	T-ratio	P-value
Constant	-0.0027	-0.44	0.66
$\Delta\ln(IBUS_{t-1})$	0.0162	0.18	0.86
$\Delta\ln(IBUS_{t-2})$	0.0443	0.47	0.64
$\Delta\ln(IBUS_{t-3})$	0.1943	2.23	0.03
$\Delta\ln(IBUS_{t-4})$	0.2334	2.68	0.01
$\Delta\ln(GDP_{t-1})$	1.6347	2.91	0.01
$\ln(IBUS_{t-1}) - \ln(KNH_{t-2}) - \Delta\ln(GDP_{t-1}) + 5.583 - 9.441(\ln(BETA_{t-1}) - \Delta\ln(GDP_{t-1})) + 0.673(\ln(KNH_{t-2}) - \ln(GDP_{t-2}) + \ln(WACC_{t-1}))$	-0.0906	-2.65	0.01
$CGEAREX_{t-2}$	-0.0006	-0.71	0.48
$1985Q1_t$	0.0795	3.19	0.00
$1985Q2_t$	-0.1571	-5.92	0.00
R^2	0.5502		
Standard error	0.0243		
LM serial correlation: $F(4,69)$	0.6903		0.60
RESET: $F(1,72)$	1.7112		0.20
Normality: Chi^2 (2)	0.5406		0.76
Koenker heteroscedasticity: $F(1,80)$	1.7292		0.19

IBUS is business investment, GDP is GDP, KNH is the non-residential capital stock, BETA is one minus the business sector depreciation rate, WACC is the weighted average cost of debt and equity, CGEAREX is our measure of balance sheet disequilibrium, and 1985Q1 and 1985Q2 are impulse dummies for their respective quarters.

Table F: Business investment equation with restricted time period

Dependent variable: $\Delta\ln(IBUS_t)$ Estimation period: 1987 Q2 to 2003 Q3			
	Coefficient	T-ratio	P-value
Constant	0.0044	0.67	0.51
$\Delta\ln(IBUS_{t-3})$	0.1641	1.48	0.14
$\Delta\ln(IBUS_{t-4})$	0.1125	1.06	0.29
$\Delta\ln(GDP_{t-1})$	1.7040	2.71	0.01
$\ln(IBUS_{t-1}) - \ln(KNH_{t-2}) - \Delta\ln(GDP_{t-1}) + 5.583 - 9.441(\ln(BETA_{t-1}) - \Delta\ln(GDP_{t-1})) + 0.673(\ln(KNH_{t-2}) - \ln(GDP_{t-2}) + \ln(WACC_{t-1}))$	-0.0959	-2.66	0.01
$CGEAREX_{t-2}$	-0.0015	-2.01	0.05
R^2	0.4409		
Standard error	0.0224		
LM serial correlation: $F(4,56)$	0.1645		0.96
RESET: $F(1,59)$	2.5148		0.12
Normality: Chi^2 (2)	0.3581		0.84
Koenker heteroscedasticity: $F(1,64)$	1.4899		0.23

IBUS is business investment, GDP is GDP, KNH is the non-residential capital stock, BETA is one minus the business sector depreciation rate, WACC is the weighted average cost of debt and equity, and CGEAREX is our measure of balance sheet disequilibrium.

Chart 19: Business investment equation actual and fitted values (equation reported in Table D)

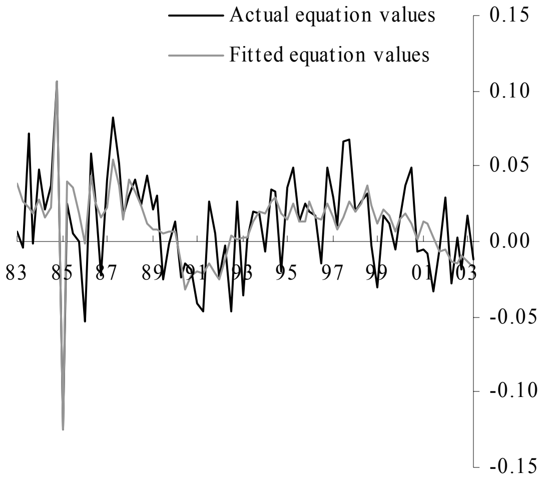


Chart 20: Business investment series actual and fitted values (equation reported in Table D)

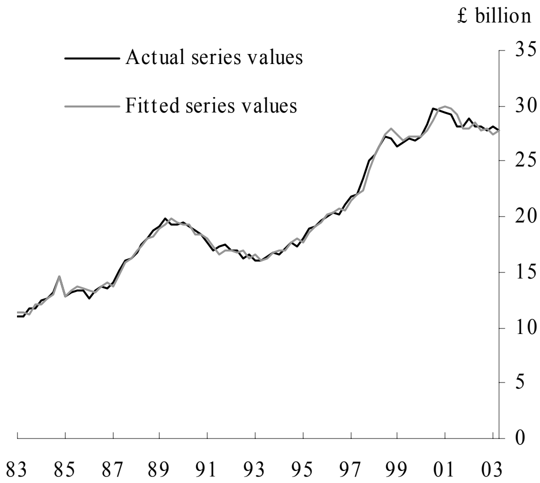
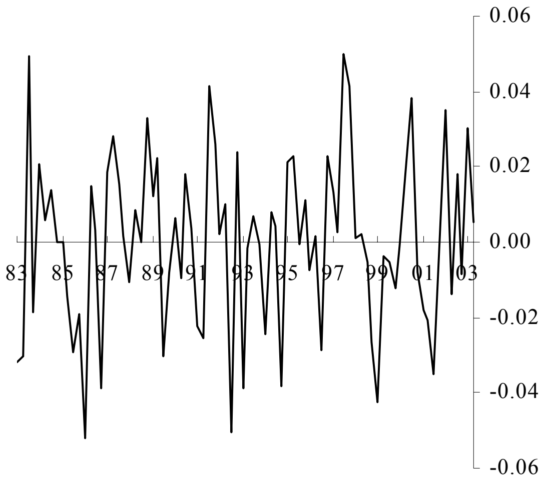
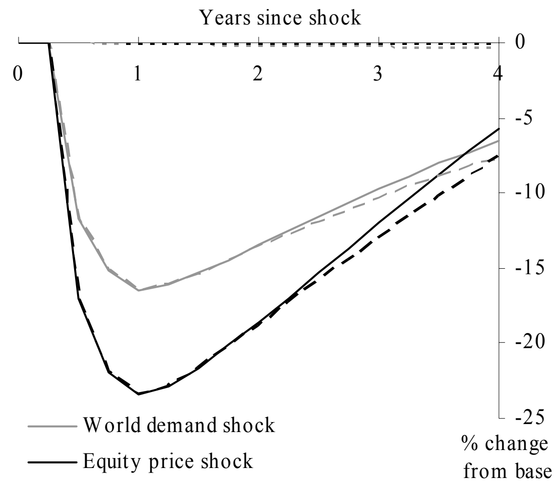


Chart 21: Business investment equation residuals (equation reported in Table D)



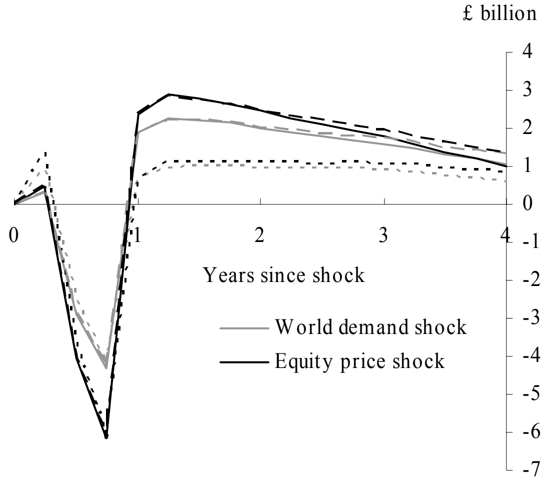
Appendix 6: Simulation properties

Chart 22: Response of dividends to shocks[(a)]



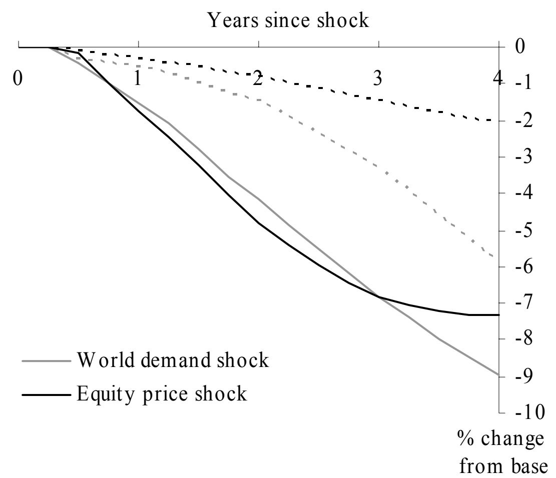
(a) Solid line represents the response using the equations that incorporate balance sheet adjustment; the broken line does not allow investment to adjust. The dotted line shows the response using equations without the balance sheet adjustment term.

Chart 23: Response of net equity finance to shocks[(a)]



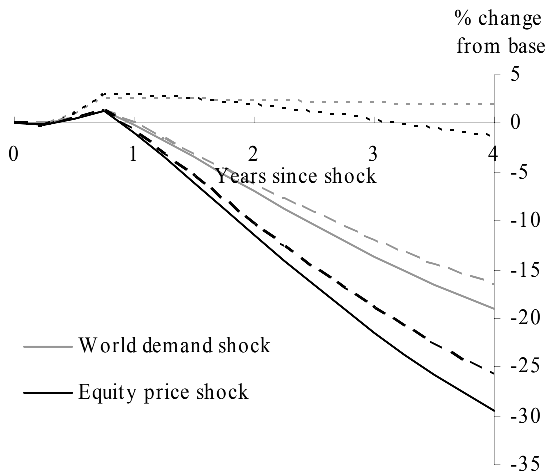
(a) Solid line represents the response using the equations that incorporate balance sheet adjustment; the broken line does not allow investment to adjust. The dotted line shows the response using equations without the balance sheet adjustment term.

Chart 24: Response of business investment to shocks[(a)]



(a) Solid line represents the response using the equations that incorporate balance sheet adjustment. The dotted line shows the response using equations without the balance sheet adjustment term.

Chart 25: Response of net debt to shocks[(a)]



(a) Solid line represents the response using the equations that incorporate balance sheet adjustment; the broken line does not allow investment to adjust. The dotted line shows the response using equations without the balance sheet adjustment term.

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