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Pension Funding Constraints and Corporate Expenditures

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Abstract

This paper examines the impact of a company's pension contributions on its dividend and investment policies. The effects of shocks to cash flows on these corporate expenditures are identified by changes to pension funding regulations. Using a sample of DB pension schemes in FTSE350 UK listed firms we find a strong negative relation between pension contributions and corporate dividends even after controlling for the correlation between funding status and unobserved investment opportunities. We find that the more stringent funding requirements under the Pensions Act 2004 had a more pronounced effect on both dividend and investment sensitivities to pension contributions.

JEL Classification: G11, G18, G23, G32, G35, C23

Keywords: Pension contributions, financial constraints, dividend sensitivity, investment sensitivity, Pensions Act 2004

I. Introduction

Recent legislation in the UK (Pensions Act 1995, Pensions Act 2004) has required companies to ensure that their defined benefit (DB) pension liabilities are appropriately funded through mandatory pension contributions. In response to the Maxwell scandal, the Pensions Act 1995 introduced a Minimum Funding Requirements (MFR) for sponsors of DB pensions, and the Pension Act 2004 strengthened the regulatory regime by introducing scheme-specific funding requirements and established the Pension Regulator with the powers to require companies to fully fund their pension liabilities. In the presence of financing pressures, meaning it is costly for companies to raise external finance, such regulations may impose constraints on company expenditures, since increased pension contributions will reduce the proportion of earnings available for investments and/or dividends payable to shareholders. It is well-known that in perfect markets these decisions are unaffected by financial considerations, but there is a large literature focusing on balance sheet adjustments in the presence of financial constraints (Hubbard, 1998). If required pension contributions act as a shock to cash flows, an increase in a firm's pension contributions may influence other uses of the firm's capital such as dividends or investments because otherwise the firm will need costly external finance.

Bunn and Trivedi (2005) have previously established a negative relation between pension contributions and dividends for UK listed companies. However their sample only extends to 2002, and does not include information on pension funding status - defined as the percentage deficit of the pension scheme - since companies have only been required to reveal this information after the introduction of accounting standard FRS17 in 2001. In the absence of funding status details it is not possible to separate out firms with defined contribution (DC) pension schemes; yet such firms are not required to make mandatory pension contributions. In addition Rauh (2006) cautions whether a negative relationship between investments and pension contributions should be interpreted as evidence for financial constraints, since this correlation could also imply limited investment opportunities with firms making voluntary pension contributions instead. He suggests that to identify the effect of required pension contributions on investments one needs to condition on pension funding status, since in the US when funding status is negative, regulations require companies to make pension contributions. But he notes that funding status might be correlated with investment opportunities, since if a firm has funding problems this could be because asset values are low due to low investment returns. Similarly, funding status might be correlated with dividends, through investors' preferences. For example, in the UK the 1997 changes to dividend tax relief for pension funds may have induced funding problems and at the same time changed investors' preferences for dividends. Rauh (2006) argues that since the function relating funding status to investment opportunities or dividend preferences is different from the function relating funding status to pension contributions, it is possible to identify the effect of contributions on investment and dividends.[1]

We extend the research on dividend/investment sensitivity to pension contributions, in two ways. First we investigate whether for UK firms the relationship persists after controlling for the potential correlations between the firm's pension funding status and unobserved investment opportunities (Rauh, 2006), and unobserved preferences for dividends, making use of data on pension funding status, that has only become available in the UK after the introduction of transitional arrangements associated with the new accounting standard from 2001. Second, we examine whether the scheme-specific funding requirements and the establishment of the Pension Regulator under the Pensions Act 2004, with the enhanced powers to ensure companies' pension liabilities are fully funded, has further affected dividends and/or investments. In the UK between 1995 and 2005, private-sector DB pension schemes were subject to the MFR (Pensions Act, 1995). However there was widespread dissatisfaction with the operation of the MFR (Myners, 2001), which was replaced with a new scheme-specific funding objective under the Pensions Act 2004, and the establishment of a Pensions Regulator with the power to require companies to make contributions to ensure that this funding objective is met. These regulations imply that mandatory pension contributions are exogenous and cannot be manipulated by managers. This is the key to the validity of our empirical specifications, as required pension contributions are an independent source of financial pressure distinct from those imposed by other cash flow requirements of the firm.

For a sample of UK listed firms with at least one DB pension scheme from 2001 to 2005, we find a strong and negative relation between pension contributions and corporate dividend payments even after controlling for the correlation between funding status and unobserved investment opportunities. Although when we replace the total contributions with simulated mandatory pension contributions, the contribution variable loses its explanatory power. We find a weaker set of results when applied to the investment equations, where although investment is negatively related to pension contributions, the relation is not statistically significant in contrast to the results for the US in Rauh (2006). In assessing the effectiveness of the funding requirements under the Pensions Act 2004, we find that dividends and investments are more sensitive to the contributions made under the Pensions Act 2004 rather than the smoothed contributions under the earlier MFR.

The rest of the paper proceeds as follows. Section 2 discusses the theories of balance sheet adjustments in imperfect markets. Section 3 explains pension funding requirements in the UK and introduces the empirical specifications for dividends and investment. Section 4 describes the sample

[1] The relationship between pension funding status and investment opportunities is likely to be smooth, whereas the correlation between mandatory contributions and funding status is given by the legal framework, with a 'kink' at 100% funding ratio. This will be discussed in more detail in Section 3.

of firms used in this study and provides descriptive statistics on the variables of interest. Section 5 reports the initial set of empirical results for the period 2001-2005. Section 6 presents the evidence from adding the more recent data after the introduction of the new funding requirement and section 7 concludes.

II. Pension contributions and balance sheet adjustments

Benito and Young (2007) observe that whatever the behavioural models for company dividend and investment decisions, all corporate expenditures are linked through the sources and uses of funds equation, which for any time *t* can be expressed as:

$$(1-\tau)\Pi_t + \Delta E_t + \Delta D_t = d_t + (1-\tau)r_t D_t + I_t \qquad (1)$$

where τ is the corporate tax rate, Π are the accumulated profits available, ΔE is the value of new equity issues, and ΔD is the quantity of new bond issues or new debt raised at time *t.* These sources of corporate expenditures (after-tax profit plus new equity issues and new bond issues) must equal the uses of those funds, defined as the sum of dividends (*d*), interest payable on outstanding debt (where *r* is the interest rate and the net interest rate reflects debt repayments being tax-deductible), and investments (*I*).

Pension contributions can be itemised as a component of corporate expenditures, and may be included into the firm's budget constraint (1). We may rewrite the net profit after deducting pension contributions (*PC*) from gross earnings (Π_t^{gross}). Then, assuming that gross earnings are exogenous, and holding the company's equity and debt volumes constant, an increase in required pension contribution must reduce either dividends or investment, or both. This can be seen by rearranging equation (1) as:

$$d_t + I_t = (1-\tau)\left(\Pi_t^{gross} - r_t D_t\right) + \Delta E_t + \Delta D_t - (1-\tau)PC_t \qquad (2)$$

Equation (2) serves as the fundamental constraint for our empirical tests of dividend and investment decisions. If a firm's DB pension scheme is in deficit, due to either an unexpected increase in pension liabilities or a decrease in the value of pension assets, the sponsoring company will need to make contributions into the pension scheme from its sources of funds, according to (2) and this will leave less money available for either investments or dividends.

Myers (2001) focuses on two alternative theories as to why balance sheet structures might matter in investment decisions: the trade-off theory and the pecking-order theory. The trade-off theory predicts that since debt interest payments are usually tax-deductible, companies will trade-off these benefits with the higher likelihood of costly financial distress or credit down-grading caused by higher leverage. According to this theory, an increase in pension contribution should have no effect on a firm's total borrowings, as firms are already at their optimal leverage that fully exploits the corporate tax shields. Holding everything else constant, an increase in corporate expenses through higher pension contributions has to be offset by lower dividends or investment or both.

The pecking-order theory is based on information asymmetries between managers and the stock market, and asserts that the financing of investments by a firm is undertaken by first using internal resources, then debt and, as a final resort, equity (Myers and Majluf, 1984). As firms prefer internal to external finance, firms with increased pension contributions will have to reduce dividend payments to keep the same level of internal funds for capital investment or alternatively cut their expenditures on investment as a result of reduced availability of internal funds. Even if a firm turns to external finance, it will do so by borrowing and investment will be lower due to the increased cost of external capital. Although some authors (Shyam-Sunder and Myers, 1999) argue that empirically the pecking-order hypothesis outperforms the trade-off hypothesis, other work (Rajan and Zingales, 1995) find support for both theories, since large companies tend to have higher debt ratios, but more profitable companies have lower debt ratios. Tests of the pecking-order versus trade-off theories have concluded that the pecking-order theory applies to large mature firms, and the trade-off-theory to small, young growth firms (Fama and French, 2002; Frank and Goyal, 2009).

The related financial constraints literature has debated the interpretation of investment-cash flow sensitivities. By also assuming that external finance is more costly than internal finance, Fazzari, Hubbard and Peterson (1988) show that greater investment-cash flow sensitivities of firms that are *a priori* more financial constrained, which they regard as evidence of the existence of financial constraints. However Kaplan and Zingales (2000) under different definitions present counter evidence showing that less financially constrained firms exhibit significantly greater sensitivities than firms that appear more financially constrained. In fact correlations between cash flows and investments may be spurious for two reasons. Firstly, cash flows might be correlated with omitted variables representing investment opportunities (Blanchard, Lopez-de-Silanes and Shleifer, 1994). Secondly, Franzoni (2009) points out that the correlation may represent agency problems with managers investing cash flows in empire-building.

Benito and Young (2007) note that the 'new view' of dividend taxation (King, 1977; Auerbach and Hassett, 2002) implies that firms' real investment decisions are predetermined because of differential taxation of corporate and personal income. The `new view' also predicts that firms prefer internally generated funds for investments and distribute residual funds as dividends. Benito and Young (2007) find that the response of dividend policies of UK companies to changes in cash flows and investments is consistent with the new view approach. With respect to an increase in pension contributions, according to the 'new view', this will reduce the amount of internally available funds for investment. Therefore to keep investments at their profit maximizing level, dividends will be adjusted downwards. Bell and Jenkinson (2002) demonstrate that after the UK 1997 tax reforms which removed the ability of tax-exempt institutional investors to reclaim dividend tax credits, these investors had a weaker preference for dividends. Both Khan (2006) and Renneborg and Trojanowski (2011) find that pay-out policy depends on shareholders preferences for dividends. Bunn and Trivedi (2005) apply a dynamic panel data model to the dividend and investment equations and estimate the effect of pension contributions on corporate expenditures. Consistent with both trade-off and pecking-order theories, they find pension contributions are negatively and significantly related to both dividends and investment, although the evidence is weaker on investment.

Webb (2007) has argued that agency conflicts between shareholders and pension plan holders, will affect both dividend and investment policies, since firms with large pension deficits who are acting in the interests of their shareholders will be more inclined to pay out cash flows and to either underinvest (due to a debt-like overhang of pension liabilities) or invest in risky projects (due to risk-shifting). Cocoa and Volpin (2007) find evidence of risk-shifting since firms that are more highly leveraged and have a greater percentage of pension fund trustees who are insiders, tend to invest a greater percentage of pension fund assets in equities. In contrast, Rauh (2009) finds that firms with poorly funded pension plans and thus the greatest incentives to risk shift, are more likely to invest in safe assets such as government bonds and cash. He suggests that risk-shifting incentives are dominated by risk-management incentives to avoid costly financial distress. Franzoni (2009) examines the stock price reaction to mandatory pension contributions, and finds a larger fall in stock prices for those firms that are a priori financially constrained. Overall he reports that overinvestment is the more significant problem for large firms, but underinvestment is more characteristic of smaller firms.

We have argued that the current funding status of a pension scheme can affect investments. Rauh (2006) considers the endogeneity between funding status and investment by separating firm cash flows into pension and non-pension-related components, and finds that the negative relation between capital expenditure and pension contributions still holds even when controlling for the correlations between the pension funding status and the firm’s unobserved investment opportunities. However these effects may not be symmetric for overfunded (fair value of scheme assets greater than fair value of liabilities) and underfunded (fair value of assets is less than liabilities) schemes, both because of the limits imposed on scheme overfunding and because managers could anticipate the gains from a surplus in the pension plan due to short termism and adjust corporate expenditures accordingly (Franzoni and Marin, 2006).

III. Regulatory funding requirements and empirical specifications

The funding requirements for DB pension plans in the UK were established after the Maxwell scandal of 1991. As a part of the Pensions Act 1995, the MFR was introduced from April 1997 and applied to most private-sector DB pension schemes. The MFR essentially established a baseline ratio of pension assets to scheme liabilities in order to cover the pensioner benefits in the event of the scheme being wound up. For a scheme with a funding level less than 90%, the sponsor was required to make up the shortfall below 90% within three years, whereas for schemes between 90% and 100% funded the shortfall had to be paid off over a period not exceeding ten years. The Pensions Act 1995 also enforced a limit for scheme overfunding, with schemes that were more than 105% funded required to reduce their surplus by improving benefits or a reduction in contributions.

However the MFR was criticised by Myners (2001) for three reasons. First, in a number of cases, the level of assets required by the MFR proved insufficient to provide the benefits promised by the scheme. Second, it increased the regulatory costs for sponsoring firms without delivering the level of security as expected. Third, it made firms focus on meeting the requirements of the MFR, rather than on developing an appropriate funding strategy for meeting their specific pension commitments, and may have hampered firms from making efficient investment decisions. The Pensions Act 2004 replaced the MFR from September 2005 with a new scheme-specific ‘statutory funding objective’ (SFO), allowing more flexibly to individual schemes' circumstances whilst at the same time protecting members' benefits. Under the new act, pension scheme trustees are required to adopt an appropriate recovery strategy for funding their pension commitments consistent with the SRO, and making up any funding deficits, given advice from the actuary. Further, pension fund trustees are allowed the flexibility to choose the optimal funding plans that are ‘*appropriate having regard to the nature and circumstances of the scheme*’ (Pensions Act 2004, Section 226 Point 3), whether it is a short-term funding shortfall caused by cash flow difficulties or temporary decrease in asset values, or relates to its long-term pension obligations. For example, in light of the market downturn in 2008, the Pensions Regulator has noted that more schemes have used this flexibility to back-end load deficit contributions (higher contributions towards the end). This practice may reflect the expectation that funding positions would improve in the future from the valuation period under consideration (The Pensions Regulator, 2009; page 5). In addition, under the Pensions Act 2004, the responsibilities of the trustees are backed up by the Pensions Regulator (from April 2005) who is required to approve the schedule of contributions in the recovery plan, and has the power to review these contributions.

The empirical specifications for dividends and investments follow those by Benito and Young (2007), although we choose to scale the variables by A_{it} —year-end book value of total assets of the firm —where applicable rather than sales or capital stock.[2]

$$
\begin{aligned}
\frac{D_{it}}{A_{it}} = \sum_{j=1}^{2} \alpha_j \frac{D_{it-j}}{A_{it-j}} + \alpha_3 \frac{I_{it-1}}{A_{it-1}} + \alpha_4 \frac{CF_{it-1}}{A_{it-1}} + \alpha_5 cgr_{it-1} + \alpha_6 br_{it-1} \\
+ \alpha_7 Q_{it-1} + \alpha_8 \frac{PC_{it-1}}{A_{it-1}} + \mu X_{it-1} + \sum_{t=2002}^{2004} \gamma_t^D \tau_t + \zeta_i^D + \varepsilon_{it}^D
\end{aligned}
\qquad (3)
$$

where D_{it} is the firm's dividend net of tax, I_{it-1} is investments in the previous year, CF_{it-1} is non-pension cash flows in the previous year, calculated as after-tax profit plus depreciation, cgr_{it-1} is the capital gearing ratio, br_{it-1} is the borrowing ratio, Q_{it-1} is Tobin's Q, X_{it-1} is a set of controlling variables that accounts for the funding status defined as the net deficit of a pension scheme (scaled by assets)[3] and PC_{it-1} are pension contributions disclosed in the previous year's accounts. We will distinguish below between total pension contributions and mandatory contributions. The variable τ_t is a dummy variable that equals to 1 for year t and 0 otherwise, so by construction the term $\Sigma\gamma_t^D\tau_t$ stands for the common year effects in the panel regression and ζ_t is the company specific effect whilst ε is the error term, and where the superscript D denotes coefficients in the dividend specification. These year and company fixed effects allow for both changes in economic conditions on dividend payments, and the characteristics of some companies to be either high or low pay-out types. All specifications (for both dividend and investment equations) include a constant term which is unreported.

Generally speaking, according to both trade-off and pecking-order theories α_8 is expected to be negative if pension contributions are treated as 'negative' cash flows. If the pension deficit has either a contribution or liquidity effect on corporate expenditures and is correlated with the unobserved investment opportunities, it should be negatively related to investments, and hence positively related to dividends, as lower investment expenditures will increase the available funds for dividend payments, so μ is expected to be positive. Also agency theories (Webb, 2007) would predict a positive relationship between pension deficits and dividend payments. As previously discussed, firms prefer to finance investment through retained earnings because of asymmetric information (pecking-order theory) or differential taxation ('new view' of dividend taxation) and therefore firms with better investment opportunities or large investment volumes are less willing to pay dividends. So a testable hypothesis is that α_3 is negative. Since cash flow is highly correlated

[2] Most of the investment literature chooses the scaling variable as either assets or capital. See for example, Kaplan and Zingales (2000), Baker, Stein and Wurgler (2003), and Rauh (2006).
[3] So *Funding Status* is negative for overfunded firms and positive for underfunded firms.

with retained earnings, dividends should react positively to it, i.e. $\alpha_4 > 0$ (Auerbach and Hassett, 2002).

The capital gearing ratio (*cgr*) and borrowing ratio (*br*) proxy for financial pressures faced by firms; with the intuition being that firms with required high interest payments on debt are more likely to be facing financial pressures. We define *br* to be the Nickell and Nicolitsas (1999) borrowing ratio, a proxy of general financial pressure other than pension contributions, calculated as net interest payments divided by pre-tax profits. The effect of debt on dividends (and investments) is ambiguous, as according to the trade-off theory, by adjusting debt to its optimal level, investments or dividends do not need to change as the adjustment can be undertaken through raising new equity. However according to the pecking-order theory, leverage represents the firm's need for external finance and a higher debt level may imply that the firm has less internal funds for dividend payments or investments to reflect a higher cost of capital; so the leverage ratio should be negatively related to corporate expenditures.

Tobin's Q is defined as the ratio of the market value of a firm's assets to the replacement cost of the firm's assets. It measures how the stock market values the firm's assets reflect its growth prospects and hence the unobserved investment opportunities of the firm. However Tobin's Q will only imperfectly measure investment opportunities, since it also explains differences in diversification and corporate governance (Chung and Pruitt, 1994). If investment opportunities are negatively related to dividend payments, this would imply a negative relation between Q and dividends, as a higher Q implies an increased demand for investment funds (i.e. $\alpha_7 < 0$). We follow Rauh (2006) and set Q simply as the market-to-book ratio of firm assets, which is calculated as

$$Q_{it} = \frac{MktCap_{it} + A_{it} - CommonEquity_{it} - DeferredTax_{it}}{A_{it}} \quad (4)$$

where $MktCap_{it}$ is the market capitalisation of a firm. The modified specification for investment is

$$\frac{I_{it}}{A_{it}} = \sum_{j=1}^{2} \beta_j \frac{I_{it-j}}{A_{it-j}} + \beta_3 \frac{S_{it-1}}{A_{it-1}} + \beta_4 \frac{CF_{it-1}}{A_{it-1}} + \beta_5 cgr_{it-1} + \beta_6 br_{it-1} + \beta_7 Q_{it-1} + \beta_8 \frac{PC_{it-1}}{A_{it-1}} + \upsilon X_{it-1} + \sum_{t=2002}^{2004} \tau_t^I \zeta_t + \eta_i^I + \varepsilon_{it}^I \quad (5)$$

where S is the total sales of the firm, the other variables are as previously defined in the dividend equation and the superscript I represents coefficients in the investment equation. The coefficient for pension contributions (β_8) should be negative according to the afore-mentioned capital structure theories but υ is expected to be negative due to the positive correlation between pension assets and investment. The estimates for debt level (β_5 and β_6) should also have the same effect on investment as in the dividend equation. As the new explanatory variable, total sales (*S*) is correlated with the current cash flow (*CF*) one would expect similar patterns for the estimates of these two variables. And if *Q* proxies unobserved investment opportunities, it should be positively related to investment volumes (i.e. $\beta_7 > 0$)

The financial constraint literature, which argues that firms prefer internally generated funds over costly external finance such as bonds or equity, implies a positive relationship between cash flows and expenditures on investment. However, the importance and magnitude of the investment-cash flow sensitivity (β_4) is less explicit given the various pieces of evidence found in the investment-cash flow sensitivity literature (Fazzari, et al., 1988; Kaplan and Zingales, 2000) and the debate over how well cash flows can proxy for the financial constraints of firms. In this paper we are able to identify the effect of shocks to cash flows on corporate expenditures by focusing on the response of companies to required pension contributions, which are kinked at the point that the funding status is negative. For both investment and dividend equations, the first and second lags of the dependent variable are included as explanatory variables. This approach allows for the persistence in the dependent variables, especially for dividends (Lintner, 1956), and implies a positive estimate for lagged dividends (α_1 and α_2).

Both equations (6) and (8) are fixed effects dynamic panel data (DPD) models by construction. By including lagged dependent variables in the right-hand side, the regression errors are no longer uncorrelated with the independent variables. In this case, ordinary least square (OLS) and static panel data (within-group) models both yield biased estimations, and as a solution we use the generalised methods of moments (GMM) estimator proposed by Arellano and Bond (1991) and Arellano and Bover (1995)[4]. We employ the two-step robust GMM-system estimator introduced by Blundell and Bond (1998) which Benito and Young (2007) report is appropriate for their study of dividend and investment behaviours. This method requires the absence of second-order serial correlation in residuals (and ideally, significant first-order serial correlation). The validity of the instruments is examined using the Sargan test of over-identifying restrictions.

IV. Sample and descriptive statistics

There were 286 firms who were constituents of the FTSE350 Index at 30th June 2002 and reported pension contributions in their annual reports; and of these, 220 companies had at least one DB

[4] Where both first- and second-order lagged dependent variables are included, the validity of the GMM estimators lies on the assumption that there is only first-order serial correlation within dependent variable but no second-order serial correlations in the differential equations. These assumptions are testable and the results are reported in Section 5 below. We repeated our analysis using a one-step GMM system, and the results are very similar..

scheme, and 66 had no DB schemes but at least one defined contribution (DC) scheme. Company accounts data, except for the pension funding status, are taken from Thomson Financial Datastream Historical Company Accounts data (1965-2005)[5]. We refined the sample criteria to include only those firms that had at least three years' worth of annual data for all of our variables, and this reduced the sample to 200 firms. This included 164 firms with at least one DB scheme, and 36 firms with at least one DC scheme. For our sample of firms with at least one defined benefit pension scheme, pension funding status data were hand-collected from the individual company's annual reports and accounts based on FRS17/IAS19 disclosures from 2001, the first year such disclosures were available according to FRS17. Firms are grouped into financial years by the date of their annual reports. A financial year is defined as being from 1st July in the previous year to 30th June in the following year; and the data is initially collected over four consecutive financial years from 2001/02-2004/05, and subsequently extended with the addition of two more financial years 2005/06- 2006/07. As both the dividend and investment specifications have lagged dependent variables up to the second order, the full data ranges from financial year 1999/2000 to 2006/07. The size of the initial sample is 889 year-end observations, on 200 individual firms.

Table 1 reports the descriptive statistics and the distribution of the variables of interest. All variables are winsorised at 99% level to prevent any outlier effects. There are three data samples used in our study, and descriptive statistics on each of these samples are presented in Panels A, B, and C in Table 1. Panel A reports on the sample of 200 firms with either at least one DB or DC scheme over the financial periods 1999/2000 - 2004/05. Panel B reports on the sample of 164 DB-only firms over the same period. A third sample of DB-only firms over the financial periods 1999/2000 - 2006/07 is reported in Panel C, and will be discussed in Section 6 below. Comparing panels A and B shows the differences between companies with a DB scheme and those with a DC scheme. It would appear dividends and pension contributions are slightly lower and investments slightly higher in DC firms compared with DB firms, and we will returns to explaining these differences in a multivariate environment in the empirical Section 5 below.

Panel B represents the main sample for our empirical work in Section 5. The mean dividend-to-asset ratio for this sample is 5.6% and the median is 4.0%. Corporate expenditures on investment have a mean (median) of 6.4% (5.8%) over assets. The cash flow variable (*CF*) is calculated as after-tax income plus depreciation. Normally this is the cash flow reported on income statements and does not contain pension contribution data and is consistent with decomposition of corporate expenditures in equation (1). The mean ratio of cash flow to assets is 14.4%. The capital gearing

[5] Post-2005 most financial data are taken from Thomson ONE Banker, since after 2005 Datastream removes data that is no longer published in company reports from its dataset.

ratio (*cgr*) is taken from Datastream (item x731) and the borrowing ratio (*br*) uses the Nickell and Nicolitsas (1999) definition, calculated as net interest payment divided by pre-tax profits. The borrowing ratio has an average value of 14.8%, which is only half the value of the mean borrowing ratio (31.8%) in Bunn and Trivedi (2005). This can be explained as the firms in our sample being larger UK companies with perhaps fewer financial pressures, proxied by the borrowing ratio. The mean and the median values of Tobin's *Q* is 2.13 and 1.62 respectively, and these values are comparable with the US values in Rauh (2006).

The pension contribution data uses the company accounts reported in Datastream (item x114: pension contributions). Under the MFR, pension contributions may be smoothed over a number of years. Bunn and Trivedi (2005) discuss this issue and compare the reported smoothed figure with non-smoothed hand-collected data on pension contributions from company accounts. They report that the Datastream (x114) variable of pension contributions captures the time-series and cross-sectional variations exhibited by the 'true values'. The mean (median) pension contribution is 1.7% (1.3%) of total assets. Figure 1 shows the distribution of pension contributions relative to assets for the sample years. The mean values are greater than the median values in all of the four financial years 2001/02 – 2004/05, indicating that the distribution of pension contributions is positively skewed. Moreover, it can be seen that the contribution level remains relatively stable over the period, which is consistent with pension contributions being smoothed over time.

Funding Status measures the difference between the present value of pension liabilities and the market value of pension assets, and a positive value means the scheme is in deficit (underfunded). This measure is equivalent to the retirement benefit liabilities disclosed in the balance sheet under FRS17/IAS19 and represents the true liabilities of the firm. *Overfunding* (*Underfunding*) is the absolute value of *Funding Status* for overfunded (underfunded) firms. The mean ratio of pension deficits to assets (*Funding Status*/*A*) is 9.5%. 601 of the 675 observations are underfunded, representing 89% of all sample firms as suggested by the *FundingDummy* variable, coded as 1 for underfunding and 0 otherwise. These figures illustrate the severe shortfall within UK occupational pension schemes in recent years recognised after the introduction of FRS17. The average overfunding and underfunding over assets are 12.3% and 12.5% with median values of 2.5% and 7.2%, respectively.

To examine a nonparametric relation between funding status and pension contributions, Figure 2 reports the results of kernel smoothing of *PC*/*A* on pension funding status *Funding Status*/*A* using the Epanechnikov kernel. Except at high levels of overfunding, there is a monotonic relationship between pension contributions and the deterioration in funding status. Moreover, for schemes with less severe funding problems, the change of pension contributions with respect to funding status is relatively small and stable, whilst for schemes with larger deficits, pension contributions increase dramatically as the funding status worsens. This finding is consistent with the application of different MFR smoothing regimes depending on the level of funding status.

V. Empirical results

This section reports the regression results for the empirical models over the period 2001/02-2004/05 using the two-step GMM-system estimator; first considering the effect of pension contributions on dividends and then on investment. Specification (1) in Tables 2 and 3, include firms with both DB and DC pension schemes, but in the subsequent specifications we focus only on those firms with DB schemes, since we are interested in the effect of funding status on dividends and investments, and this variable is only relevant for firms with DB schemes.

Dividend equations

Table 2 shows the empirical results from estimating equation (3) between 2001/02 and 2004/05. For all estimates in Table 2, the GMM differenced equation uses all available instruments from $t = 2$ to $t = 6$.[6] Specification (1) is our initial model, including firms with either DB or DC pension schemes, and we introduce a dummy variable *DB* if the company has a DB pension scheme. It can be seen that the *DB* dummy is negative and highly significant, meaning that firms with DB pensions pay a substantially lower dividend than firms with only DC pensions.

Specification (2) is the basic dividend specification for DB schemes only without pension funding status included. The coefficient on cash flow (*CF/A*) has a point estimate of 2.547. Although not significant within conventional levels, it suggests higher cash flows will increase firms' dividend payments as predicted by equation (1). The proxy for unobserved investment opportunities, Tobin's *Q* has a point estimate of –0.042 and is significant at the usual levels. This result is consistent with both the pecking-order and the new view of tax theories: a higher level of anticipated investments, proxied by higher *Q* level, tends to reduce dividend payments, and are financed through retained earnings. Although not statistically significant, actual investments (*I/A*) are negatively related to dividends, as predicted by firms' preference for internal funds. The coefficients on leverage ratios (*cgr* and *br*) are both statistically insignificant, which is consistent with the trade-off theory as firms with optimal debt levels do not have to undertake any balance sheet adjustments.

The coefficient estimate of pension contributions in Specification (2) is –9.59 and is significant at 95% confidence level. This finding illustrates that pension contributions may be

[6] There are four firms that never pay any dividend throughout the duration of the sample and these are excluded from the analysis. Typically firms that never pay dividend are mainly new and high-tech companies.

regarded as a negative cash flow and affects the firm's budget constraints in equation (1). The absolute magnitude of the coefficient estimate is large relative to the values in Bunn and Trivedi (2005).

Specifications (3) and (4) add *Funding Status* as a control to capture the correlation between funding status and unobserved investment opportunities. Specification (3) uses the overall funding status as the control and the point estimate of pension contribution decreased to –3.82 but is not statistically significant. However when funding status is split into overfunding and underfunding in Specification (4), the *PC* variable become significantly negatively related to dividends with a coefficient of –11.85. *Funding Status* itself is positively related to dividend payments, surprisingly implying that a larger deficit is associated with higher dividends, but the effect is not significant. The coefficient estimate on overfunding is –2.14 and significant at 95% level. This implies that the positive relationship between pension deficits and dividends is mainly captured by pension surplus. A possible explanation stems from the agency predictions by Webb (2007) that managers of firms with overfunded DB scheme are less inclined to sacrifice the firm and/or pensioners' interest by paying out excess cash as dividends purely to maximise shareholder values.

We may capture the interaction between pension contributions and funding status by isolating the proportion of voluntary contributions from total contributions and then only consider the impact of mandatory contributions. We construct this variable by defining a new pension contribution variable that equals a funding status dummy (*fundingdummy* in Table 2), which is 1 for underfunded schemes with 90% funding ratio under an FRS17 valuation and 0 otherwise, multiplied by the pension contribution (*PC*/*A*).[7] Specification (5) reports the dividend sensitivity of this simulated variable using underfunding and overfunding as control variables. Although the absolute magnitude of the coefficient estimate of pension contributions has increased to –15.49, it has lost its explanatory power. This suggests that our 'simulated' mandatory contributions are relatively imprecise, especially under the MFR's smoothed funding requirements.

Specifications (6) and (7) remove the borrowing ratio from specifications (3) and (4) as it is highly correlated to the cash flow term (*CF/A*) by construction. Removing this term does not alter the results significantly though pension contributions turn out to be negatively significant with a point estimate of –5.03 in Specification (6) using pension funding status as the control variable. Dropping the borrowing ratio also increases the statistical significance of investment, which becomes significant at 90% confidence level in Specification (6) and (7) with point estimates of –0.46 and –0.75, respectively. In specifications (8) and (9), we control for firm size, by including

[7] We have chosen 90% as the threshold funding ratio because this is the level under MFR which triggers mandatory contributions. Because of the MFR smoothing funding rules in the UK context discussed in the previous sections, we do not follow Rauh (2006), who constructed the mandatory contribution as *MC = min (TC, pension deficit).*

group dummies after dividing firms into quartiles according to their total assets. The group dummies are insignificant, confirming our conjecture that size effects are not driving our results.

Webb (2007) argues that the interaction between a large pension deficit and financial leverage is likely to intensify the agency problems between shareholders and pensioners, which in turn will affect the firm's dividend and investment policies. Specification (10) examines the effect of this interaction between pension deficits and other form of firm liabilities (*cgr* × *Funding Status/A*). The interaction term appears insignificant in determining the level of dividends, although the magnitude of the coefficient estimate is higher than including the leverage ratio (*cgr*) alone.

The autocorrelation test (row AR(1) and AR(2)) checks on the dynamics of the dependent variable, and provides limited evidence of dividend persistence. First-order serial correlation is only weakly significant in Specification (6), and the absence of second-order serial correlation ensures the validity of the GMM-system estimator. Furthermore, the Sargan test of over-identifying restriction cannot be rejected in all specifications.

Investment equations

Table 3 reports the coefficient estimates of the panel regression of investment on pension contributions in equation (5) using the two-step GMM-system estimator. The inclusion of lagged dependent variables ensures the two-step estimation method is valid as there is no evidence of second-order serial correlation for all specifications. However, contrary to the findings of Benito and Young (2007), there is no clear evidence of persistence in investment and moreover, the first lag of the dependent variable is negatively significant in Specifications (1) to (3) and Specification (8) with point estimate between –0.46 and –0.40. This might be caused by the positive correlation between investment and book assets as we have defined investments as total payments on fixed assets and if this is the case, a higher value of investment in the previous year will increase total assets, which consequently reduces the value of the dependent variable. For all specifications the Sargan test is not rejected, suggesting that the over-identifying restrictions are valid in our model.

Specification (1) starts by including both DB and DC firms in the sample. The coefficient on the DB dummy variable is negative but insignificant. Specification (2) is then the base equation tested for the sample of DB-only companies. In the absence of pension funding status, pension contributions are negatively related to investment with a point estimate of -7.79 but not significant at the 10% level. The estimate is close to that in the dividend equation, providing support for the trade-off theory that balance sheet adjustments can take place through either channel. Specifications (3) and (4) add pension funding status into the basic specification and it is found to be negatively related to investment, consistent with our prediction that funding status is positively correlated to unobserved investment opportunities, though the coefficient estimates are again insignificant.

Specification (5) uses mandatory pension contributions as the explanatory variable, but investment sensitivity remains insignificant. Our findings are weaker than those in Rauh (2006), who finds a strong negative relation between mandatory pension contribution and investment, but similar to those in Bunn and Trivedi (2005), who also find a weak negative relationship between pension contributions and investments. One possible explanation for these different investment sensitivities to pension contributions between the US and UK is that the MFR requirements in the UK were less effective.

Other than pension related variables, only total sales is weakly related to total investment in Specification (3), with a point estimate of 0.118. As a robustness check, we removed the borrowing ratio in Specification (6) and (7) and this reduces the standard errors in the cash flow terms, indicating that the borrowing ratio is indeed related to cash flow and picks up some of the effect of cash flows on investments. Specifications (8) and (9) establish whether there exists any size effect within our model by adding company specific fixed effects in the panel regression but the results are not greatly altered. Another robustness test we undertook was to use the capital stock as the denominator in the investment equations as in Bunn and Trivedi (2005). These results are not reported, but although we found more significant estimates on some of the accounting variables, there was still no robust relation between pension contributions and investment. Moreover, this regression dramatically increases the magnitude of the standard errors of the pension contribution variables. In the final specification we again include an interaction term between pension deficits and financial leverage to see whether this interaction has any effect as predicted by agency theories (Webb, 2007), but again the term is statistically insignificant.

VI. Impact of post-2005 funding requirements on corporate expenditures

This section examines the impact of the new pension funding requirements after the implementation of the Pensions Act 2004 in 2005 on corporate expenditure decisions. As argued in Section 3, pension contributions made under the new funding requirements are more firm-specific and potentially are more accurate measures of mandatory payments rather than the smoothed MFR contributions.

The reason why this analysis is separated from the earlier empirical section of the paper is because the Datastream entry for pension contributions (x114) and some other variables (such as investment variables x1026 and x479) are not available in after 2005. Most of the financial data after 2005 are replaced by data from Thomson ONE Banker, except for pension contribution data. In order to undertake the analysis, the first task is to estimate the pension contributions made by individual firms using data that is available.

A DB pension scheme has two primary elements: scheme assets and scheme liabilities.

Figure 3 shows the main components of the assets and liabilities of a typical DB scheme as disclosed in the footnote of the firm's financial statement under FRS 17. The left-hand side of Figure 3 shows the composition of pension assets. The fair value of pension assets at the end of the year is calculated as the sum of asset values at the beginning of the year, investment returns on the assets and any additional contributions made to the scheme minus pension benefits paid during the year. The right-hand side of Figure 3 shows the calculation of pension obligations. There are two main kinds of costs accrued during the accounting period: service cost and interest cost. Service cost is the additional liability created because another year has elapsed, for which all current employees get another year's pension benefit for their service. Pension interest cost is the annual accrued interest on previously incurred pension benefit obligations reflecting the increase in the present value of the projected pension obligation as employees are one year closer to receiving their pension benefits. The year-end pension liabilities are equal to the sum of opening liabilities and pension costs accrued during the year minus the obligations that are paid off (benefits paid) during the year.

From Figure 3, the fair value of assets of a DB scheme in year t can be written as:

$$PA_t = PA_{t-1} + ROA_t + PC_t - PB_t \tag{6}$$

which may be rearranged in terms of PC_t to estimate implied pension contributions when such data is unavailable from Datastream. In accordance with the disclosure requirement of the pension accounting standards (FRS17 and IAS19), the fair value of scheme assets and the return on scheme assets post-2005 are available from Thompson One Banker. Although the annual benefits paid (PB_t) are not available from the Thompson dataset, this only represents a small proportion of the total pension assets, so we simulate the pension contributions using the following equation:

$$PC_t = PA_t - PA_{t-1} - ROA_t \tag{7}$$

In order to check whether the sensitivities of dividends/investment to pension contributions (α_8 and β_8 in equation (3) and (5), respectively), have changed after the new regulations were introduced, a time dummy (T_{2005}, coded as 0 for observations up to 2004/2005 and 1 in and after 2005/06, when the new funding requirements of the Pensions Act 2004 came into effect) is interacted with the PC_{it-1} variable in both dividend and investment equations, to measure the effects on the slope coefficients. In addition, changes in the intercept terms before and after the introduction of new funding requirements are captured by the individual year dummies or by the single dummy variable T_{2005}. If the new funding requirement and the required pension contributions made under the Pensions Act 2004 do prove to be more financially binding and impose additional financial pressures on firms, then the dividend/investment sensitivity should increase and the post-

2005 dummies should be significant in explaining the regression results.

Descriptive statistics for the full sample of 935 observations over 180 firms for the period 2000-2007 are given in Panel C of Table 1.[8] One noticeable difference with the earlier period is that the mean size of the simulated pension contributions is higher at 2.2% of assets. Table 4 and Table 5 show the regression results for dividend and investment equations respectively estimated over the full sample period. The first three columns in Table 4 report the empirical results using only individual year dummies for the three core specifications. Specification (1) reports the results without any funding status control, specification (2) is with funding status included, and specification (3) with over- and underfunding as control variables. The last three columns consider the change of slope coefficient for pension contribution variables as well as a specific time dummy (T_{2005}) that measures the change of circumstances before and after Pensions Act 2004 in the different specifications.

The number of observations in Table 4 increases to 891 from the 511 in Table 2, but the additional data does not alter the main results: pension contributions are still negatively related to dividend payments even after controlling for the pension funding status, although the absolute value of the coefficient over the whole sample period is reduced to -1.524. The result is probably due to the mean value of the pension contributions to assets (including the simulated values) in Panel C of Table 1 being 2.2%, which is significantly larger than the previously used PC/A variable. In specification (4) when we use the simulated mandatory contribution calculated as described in the previous section, the coefficient becomes significant and is negatively related to dividend payments. This suggests that mandatory contributions under the new pension regulation are a more accurate measure of the financial pressures facing a firm. The results are similar when using funding status as control variables. Specification (6) adds the interaction term between time and the mandatory contribution (MC) variable ($Fundingdummy_{it-1} \times T_{2005} \times (PC/A)_{it-1}$) to pick up the pre- and post-Pensions Act 2004 effects whilst Specification (7) adds a further time dummy for the years 2005/06. The estimate of α_9, which identifies the effect of the Pensions Act 2004 changes, is significantly negative in both Specifications (6) and (7), indicating a more pronounced dividend sensitivity to (mandatory) pension contributions under the new funding requirements.[9]

Turning to the investment equation in Table 5, we include both lagged ($t-1$) and contemporary (t) independent variables. Pension contributions still have no significant impact on

[8] The number of firms increases to 180 because a larger number of firms satisfy the data requirement of three years' worth of data over a longer time span of data.

[9] We also constructed additional time dummy variables allowing for changes in slope coefficients for variables other than pension contributions, such as pension funding status. However we found no significant effects of these control variables on dividend payments after the introduction of the new funding requirement.

investment when adding the additional data into the regressions in Specifications (1) and (2). However when we add both over- and underfunding as control variables in Specification (3), the coefficient estimate for pension contributions is -0.315 and significant at 95% confidence level. When using the simulated MC variable ($Fundingdummy_{it-1} \times (PC/A)_{it-1}$) in the regression, Specification (5) shows that the absolute investment sensitivities are larger when including mandatory rather than total contributions. Specifications (6) and (7) include the interaction term for time and MC ($Fundingdummy_{it-1} \times T_{2005} \times (PC/A)_{it-1}$), and the post-2005 time dummy (T_{2005}). Similar to the findings from the dividend equation in Table 4, the investment sensitivity of mandatory contributions after the introduction of the new funding rules are significantly 'more negative' than before the introduction of the new funding rules. These estimated coefficients illustrate that over the whole sample the effect of a £1 increase in total pension contributions is to reduce dividends by between £1.32 and £1.52 (Specifications (1) – (3) in Table 4). A £1 increase in mandatory contributions reduces dividends by between £0.66 and £0.95 (Specifications (4) and (5)). The effect of the Pension Act 2004 was that a £1 increase in MC reduced dividends by an additional £0.70 (Specification (6)). From the coefficients in Table 5 a £1 increase in total pension contributions reduced investments by between £0.19 and £0.32, a £1 increase in MC reduced investments by between £0.30 and £0.54. Post-2005, a £1 increase in MC reduced investments by an additional £0.23.

We have already noted that the coefficients on the simulated pension contributions in Tables 4 and 5 for the extended dataset, differ from the values in Tables 2 and 3. To check whether our simulated pension contribution data is an appropriate measure of the underlying pension contributions, the calculation in equation (7) is undertaken for observations before 2005 and the results are compared with the values for the actual pension contribution taken from Datastream item x114. The correlation coefficient between the simulated data and the Datastream disclosures is 0.812, indicating that our simulated pension contributions variable does capture most of the information in the actual pension contributions. In addition as a robustness check on our results in Tables 2 and 3, regressions were run using the simulated pension contribution for all sample years[10]. In unreported results, the coefficient on the simulated pension contributions in the dividend equation was -0.62, and in the investment equation was -0.72. In this case, only the coefficient in the investment equation is significant, suggesting that the firm-specific contributions required by the Pensions Act 2004 may have had larger effects on investment than dividend decisions. The coefficient estimates for the dummies (*Fundingdummy* and T_{2005}) are still significant, indicating that

[10] Ideally we would have used the sample before 2005, however this is not possible because of the relative scarcity of the other pension scheme data on Datastream, which is necessary to calculate the simulated contributions.

although the simulated pension contributions are a noisier measure that the contribution data used before 2005, the post-2005 pension contributions do have a significant impact on firms' expenditure decisions.

VII. Conclusions

Using a panel of all UK FTSE350 companies between 2001 and 2007 with DB pension schemes, we have established a strong negative relationship between the firm's dividend payments and its mandatory pension contributions even after controlling for the endogeneity of pension funding status on dividends and investments. We find that the effect of pension contributions on investment is weaker than in Rauh (2006), implying that in the UK the response of balance sheet adjustments to financial pressures takes place through dividends rather than real investments.

Under the MFR, pension contributions for underfunded firms were smoothed over a number of years, but after 2005, the MFR was replaced with firm-specific funding requirements, allowing firms to focus on developing optimal funding plans that are appropriate to the circumstances of the scheme, and a pensions regulator with the powers to require companies to fund their pension liabilities. We examined whether the new funding requirement under the Pensions Act 2004 had any further effect on firms' expenditure decisions. We found that the dividend and investment sensitivities to pension contributions are more pronounced in and after 2005, indicating that these regulations have had a significant effect on corporate expenditures.

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TABLE 1

Descriptive statistics

The table reports descriptive statistics on three data samples in Panels A, B, and C. The sample in Panel A is for those FTSE350 firms with either at least one DB or DC pension scheme, and with at least three years of consecutive data observations over the period 2001/02-2004/05. (Note the table includes observations in the pre-sample years of 2000 and 2001). Panel B reports statistics for the same sample-period but only for those firms with at least one DB scheme. Panel C reports the statistics for those firms with at least one DB scheme for the extended sample-period from 2001/02 to 2006/07. All data values except pension funding status data are taken from Datastream up to 2005, and Thomson One Banker after 2005. Pension funding status data is hand-collected from individual firms' annual reports based on FRS17/IAS19 disclosures. All variables are scaled by book value of assets, *A*. All variables are winsorized at 99% level to eliminate outliers; *D* is the ordinary dividends, *I* is the firm's total investment, *CF* is cash flow equal to after-tax profit plus depreciation, *cgr* is capital gearing ratio and *br* is Nickell and Nicolitsas (1999) borrowing ratio of net interest payments to pre-tax profits; *Q* is an approximation of Tobin's *Q* used by Baker, Stein and Wurgler (2003) and Rauh (2006), calculated as the market capitalisation of the firm plus book assets minus the sum of common equity and deferred taxes, divided by assets. *Funding Status* equals the market value of pension liabilities minus the present value of pension assets (a positive value means the scheme is in deficit). *Overfunding* (*Underfunding*) is the absolute value of funding status for overfunded (underfunded) schemes. The *Status Dummy* equals 1 (0) for underfunded (overfunded) schemes.

	Panel A				*Panel B*				*Panel C*			
	Data from 2000 to 2005, DB & DC firms=200, observations = 889				*Data from 2000 to 2005, DB-only firms=164, observations = 675*				*Data from 2000 to 2007, DB-only firms=180, observations = 935*			
	Mean	*Median*	*Standard deviation*	*No. Observations*	*Mean*	*Median*	*Standard deviation*	*No. Observations*	*Mean*	*Median*	*Standard deviation*	*No. Observations*
D/A	0.048	0.038	0.111	889	0.056	0.040	0.187	675	0.024	0.042	0.712	935
I/A	0.071	0.060	0.193	889	0.064	0.058	0.209	675	0.016	0.051	1.526	935
CF/A	0.147	0.143	0.424	889	0.144	0.142	0.451	675	-0.002	0.151	3.554	935
cgr	0.654	0.475	2.923	889	0.651	0.508	2.797	675	0.604	0.478	2.394	935
br	0.152	0.154	1.443	889	0.148	0.179	1.610	675	0.808	0.217	4.094	935
Q	2.174	1.663	3.693	889	2.129	1.624	1.798	675	1.649	1.526	9.932	935
PC/A	0.015	0.011	0.023	889	0.017	0.013	0.025	675	0.022	0.011	0.081	935
FundingDummy	–	–	–	–	0.890	1	0.313	675	0.906	1	0.292	935
PC/A × FundingDummy	–	–	–	–	0.016	0.011	0.025	675	0.021	0.009	0.078	935
Funding Status/A	–	–	–	–	0.098	0.059	0.218	675	0.086	0.048	0.278	935
Overfunding/A	–	–	–	–	0.123	0.025	0.327	74	0.107	0.021	0.302	88
Underfunding/A	–	–	–	–	0.125	0.072	0.183	601	0.106	0.058	0.268	847

TABLE 2

GMM-system regression of dividends on pension contributions

The table presents the results for the two-step GMM-system estimation in a fixed effect panel data model. Variables are scaled by end-of-year total book value of assets (*A*) where applicable. *D* are the firm's dividend payments, *I* are investment expenditures, *CF* is non-pension cash flows, calculated as after-tax profit plus depreciation, *cgr* is capital gearing ratio, *br* is the borrowing ratio, *Q* is Tobin's *Q* and *PC* are the firm's pension contributions. Specification (1) reports firm behaviour on dividend payments for FTSE350 companies which have either DC or DB pension schemes. The remaining specifications only include FTSE350 companies with DB schemes. Pension funding status is used as a control for its correlation with unobserved investment opportunities in Specifications (3), (6) and (8). Funding status control is underfunding and overfunding, separately in Specifications (4), (5), (7) and (9). Specifications (8) and (9) add company specific group effects into Specifications (3) and (4). Specification (10) examines the effect of the interaction between corporate debt and pension deficits on dividend payments. Sargan is a χ^2 test of over-identifying restrictions. Asymptotic robust standard errors are reported in parenthesis. *, **, *** stand for 10%, 5% and 1% significance levels, respectively.

	Dependent variable: $Dividend_{it} / A_{it}$									
Specifications	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
$(D/A)_{it-1}$	2.346*	-0.821	0.767	-1.368	-3.311	0.280	-0.616	0.538	0.465	-1.055
	(1.383)	(1.699)	(1.716)	(1.605)	(4.185)	(1.106)	(1.08)	(0.808)	(1.513)	(1.700)
$(D/A)_{it-2}$	0.028	0.025	0.010	0.030	0.025	0.009	0.024*	0.009	0.029	0.023
	(0.021)	(0.019)	(0.007)	(0.022)	(0.037)	(0.006)	(0.015)	(0.013)	(0.021)	(0.018)
$(I/A)_{it-1}$	-0.860	-0.425	-0.263	-0.635	-1.385	-0.461*	-0.745*	-0.101	-0.653	-0.687*
	(1.077)	(0.450)	(0.488)	(0.491)	(1.417)	(0.263)	(0.419)	(0.279)	(0.638)	(0.413)
$(CF/A)_{it-1}$	-1.222	2.547*	-0.218	3.196**	4.890	0.356	2.356**	-0.151	1.772*	2.100**
	(0.881)	(1.534)	(1.468)	(1.586)	(5.368)	(0.825)	(1.018)	(0.569)	(1.030)	(1.038)
cgr_{it-1}	0.001	0.009	0.000	0.010	0.016	0.001	0.005	0.001	0.005	
	(0.001)	(0.007)	(0.004)	(0.009)	(0.021)	(0.002)	(0.005)	(0.002)	(0.006)	
br_{it-1}	0.253	-0.071	0.046	-0.087	-0.083			0.072	0.017	
	(0.394)	(0.152)	(0.110)	(0.145)	(0.252)			(0.046)	(0.073)	
Q_{it-1}	-0.004	-0.042*	0.004	-0.051	-0.097	0.000	-0.039	0.000	-0.048	-0.026
	(0.054)	(0.022)	(0.010)	(0.034)	(0.123)	(0.011)	(0.025)	(0.006)	(0.035)	(0.017)
$(PC/A)_{it-1}$		-9.591**	-3.823	-11.848**		-5.033*	-8.459**	-2.553	-7.521*	-7.595***
		(4.825)	(3.921)	(5.946)		(3.233)	(3.859)	(3.930)	(3.926)	(2.797)
$(Funding\ Status/A)_{it-1}$			0.315			0.537		0.108		
			(0.576)			(0.363)		(0.240)		
$Fundingdummy_{it-1} \times (PC/A)_{it-1}$					-15.490					
					(17.630)					
$(Overfunding/A)_{it-1}$				-2.136**	2.529		-1.652**		-1.638*	
				(0.965)	(2.907)		(0.733)		(0.844)	
$(Underfunding/A)_{it-1}$				0.102	0.366		0.237		-0.023	
				(0.638)	(0.953)		(0.504)		(0.480)	
DB_t	-1.067***									
	(0.259)									
$(cgr \times Funding\ Status/A)_{it-1}$										0.031
										(0.023)
Size effects	No	No	No	No	No	No	No	Yes	Yes	No
Year effects	Yes	yes	yes	yes	Yes	yes	yes	Yes	Yes	Yes
AR(1) (*p-value*)	0.509	0.515	0.513	0.396	0.592	0.069	0.124	0.367	0.323	0.494
AR(2) (*p-value*)	0.926	0.708	0.264	0.286	0.882	0.224	0.399	0.719	0.915	0.396
Sargan (*p-value*)	0.349	0.971	0.783	0.957	0.903	0.594	0.841	0.668	0.852	0.916
Number of firms	200	164	164	164	164	164	164	164	164	164
No. of observations	634	511	511	511	511	511	511	510	510	511

TABLE 3

GMM-system regression of investments on pension contributions

The table presents the results for the two-step GMM-system estimation in a fixed effect panel data model using PcGive. Variables are scaled by end-of-year total book value of assets (*A*) where applicable. *I* are the firm's investment expenditures, *CF* is non-pension cash flows, calculated as after-tax profit plus depreciation, *cgr* is capital gearing ratio, *br* is the borrowing ratio, *Q* is Tobin's *Q*, *S* is total sales and *PC* are the firm's pension contributions. Specification (1) reports firm behaviour on the level of investments for all FTSE350 companies with and without DB pension schemes. The remaining specifications only include FTSE350 companies with DB schemes. Specifications (2) and (5) consider only the effect of pension contributions. In Specification (3) and (6) the pension funding status is used as a control for its correlation with unobserved investment opportunities. Specifications (4) and (7) the funding status control is underfunding and overfunding, separately. In Specifications (4) to (7) the borrowing ratio is excluded from the regressions. Specifications (8) and (9) add company specific group effects into Specifications (3) and (4). Specification (10) examines the effect of the interaction between corporate debt and pension deficits on the level of investments. Sargan is a χ^2 test of over-identifying restrictions. Asymptotic robust standard errors are reported in parenthesis. *, **, *** stand for 10%, 5% and 1% significance levels, respectively.

	Dependent variable: Investment$_{it}$ / A$_{it}$									
Specifications	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
$(I/A)_{it-1}$	0.112	-0.400*	-0.462**	-0.463**	-0.543**	-0.314	-0.343	-0.389	-0.433*	-0.054
	(0.297)	(0.240)	(0.219)	(0.215)	(0.271)	(0.263)	(0.224)	(0.243)	(0.251)	(0.185)
$(I/A)_{it-2}$	-0.193*	-0.155	-0.136	-0.126	-0.108	-0.093	-0.104	-0.150	-0.132	-0.054
	(0.099)	(0.151)	(0.117)	(0.128)	(0.103)	(0.144)	(0.134)	(0.136)	(0.115)	(0.130)
$(CF/A)_{it-1}$	-0.253	-0.326	0.267	0.303	0.548	0.373	0.255	0.237	0.246	0.058
	(0.655)	(1.127)	(1.019)	(1.039)	(0.957)	(0.819)	(0.838)	(0.816)	(0.885)	(1.045)
cgr_{it-1}	0.022	0.001	0.008	0.008	0.014	0.000	-0.001	0.003	0.006	
	(0.034)	(0.015)	(0.018)	(0.019)	(0.024)	(0.014)	(0.015)	(0.019)	(0.024)	
br_{it-1}	-0.097	-0.440	-0.418	-0.378	-0.538			-0.209	-0.291	-0.012
	(0.072)	(0.631)	(0.611)	(0.603)	(0.791)			(0.619)	(0.646)	(0.045)
Q_{it-1}	0.014	-0.018	-0.052	-0.054	-0.082	-0.030	-0.031	-0.034	-0.042	0.026
	(0.027)	(0.042)	(0.052)	(0.055)	(0.077)	(0.055)	(0.057)	(0.049)	(0.067)	(0.052)
$(S/A)_{it-1}$	0.025	0.129	0.118*	0.110	0.111	0.089	0.096	0.117*	0.120	0.021
	(0.040)	(0.097)	(0.070)	(0.075)	(0.079)	(0.069)	(0.071)	(0.074)	(0.086)	(0.029)
$(PC/A)_{it-1}$		-7.789	-3.714	-2.916		-1.766	-2.424	-4.542	-4.803	-2.552
		(6.357)	(7.431)	(6.788)		(5.767)	(5.863)	(5.680)	(6.425)	(4.260)
$(Funding\ Status/A)_{it-1}$			-0.859			-0.769		-0.609		
			(1.264)			(1.019)		(1.295)		
$Fundingdummy_{it-1} \times (PC/A)_{it-1}$					-4.472					
					(8.377)					
$(Overfunding/A)_{it-1}$				1.131	1.075		-2.075		3.516	
				(5.248)	(4.875)		(5.730)		(9.795)	
$(Underfunding/A)_{it-1}$				-0.786	-0.835		-0.761		-0.349	
				(1.234)	(1.163)		(1.052)		(1.219)	
DB_t	-0.233									
	(0.430)									
$(cgr \times Funding\ Status/A)_{it-1}$										-0.023
										(0.056)
Size effects	No	No	No	No	No	No	No	Yes	Yes	No
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1) (*p-value*)	0.040**	0.972	0.939	0.772	0.912	0.355	0.878	0.756	0.527	0.174
AR(2) (*p-value*)	0.428	0.987	0.402	0.461	0.570	0.477	0.286	0.839	0.754	0.445
Sargan (*p-value*)	0.408	0.892	0.905	0.774	0.842	0.827	0.764	0.795	0.679	0.300
Number of firms	200	163	163	163	163	163	163	163	163	163
No. of observations	634	496	496	496	496	496	496	495	495	496

TABLE 4

Impact of post-2005 funding requirements: dividend equation

The table presents the results for the two-step GMM-system estimation in a fixed effect panel data model using PcGive. Variables are scaled by end-of-year total book value of assets (*A*) where applicable. *D* are the firm's dividend payments, *I* are investment expenditures, *CF* is non-pension cash flows, *cgr* is capital gearing ratio, *br* is the borrowing ratio, *Q* is Tobin's *Q* and *PC* is the firm's pension contributions. T_{2005} is a time dummy set to be 0 for observations before 2005 and 1 in and after 2005. Specification (1) considers only the effect of pension contributions. In Specification (2) the pension funding status is used as a control for its correlation with unobserved investment opportunities. Specifications (3) the funding status control is underfunding and overfunding, separately. Specifications (4) to (6) use proximate mandatory contributions in the regression. The sample data range from fiscal year 2000 to 2007 and p-values for the time dummies of year 2004 to 2007 are reported. Asymptotic robust stand errors are reported in parenthesis. *, **, *** stand for 10%, 5% and 1% significance levels, respectively.

	Dependent variable: Dividend$_{it}$ / A_{it}						
Specifications	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
$(D/A)_{it-1}$	0.194	0.402	0.496	-0.793	0.568	-0.864	-0.469
	(0.908)	(0.677)	(0.420)	(0.806)	(1.812)	(0.758)	(0.765)
$(D/A)_{it-2}$	-0.008	-0.015	-0.028	0.002	0.037	-0.009	-0.007
	(0.021)	(0.024)	(0.028)	(0.023)	(0.029)	(0.021)	(0.026)
$(I/A)_{it-1}$	1.009***	0.840***	0.478	1.304***	0.698	0.848***	0.959***
	(0.130)	(0.120)	(0.722)	(0.062)	(0.844)	(0.160)	(0.170)
$(CF/A)_{it-1}$	0.100	0.052	0.047	0.216	0.169	0.217*	0.150
	(0.153)	(0.100)	(0.058)	(0.144)	(0.318)	(0.130)	(0.92)
cgr_{it-1}	-0.201***	-0.165***	-0.257***	-0.003	-0.006	0.001	0.000
	(0.051)	(0.060)	(0.089)	(0.005)	(0.012)	(0.003)	(0.003)
br_{it-1}	-0.012	-0.016	-0.020	-0.013	-0.012	-0.025	0.022
	(0.020)	(0.020)	(0.027)	(0.059)	(0.019)	(0.027)	(0.015)
Q_{it-1}	0.055***	0.044***	0.059***	0.007		0.003	0.007
	(0.005)	(0.009)	(0.015)	(0.016)		(0.012)	(0.010)
$(PC/A)_{it-1}$	-1.524***	-1.321***	-1.333**				
	(0.149)	(0.253)	(0.146)				
$Fundingdummy_{it-1} \times (PC/A)_{it-1}$				-0.947***	-0.663*	5.009**	3.340
				(0.058)	(0.390)	(2.307)	(2.083)
$(Funding\ status/A)_{it-1}$		0.343			1.072		
		(0.438)			(1.393)		
$(Overfunding/A)_{it-1}$			-1.005				
			(1.397)				
$(Underfunding/A)_{it-1}$			-0.188				
			(0.556)				
T_{2005}							0.029
							(0.031)
$Fundingdummy_{it-1} \times (PC/A)_{it-1} \times T_{2005}$						-5.701***	-4.067**
						(2.113)	(1.969)
Y2003 (p-valuel)	0.01***	0.07*	0.72	0.49	0.48	0.09*	—
Y2004 (p-valuel)	0.30	0.77	0.94	0.19	0.52	0.44	—
Y2005 (p-valuel)	0.71	0.92	0.81	0.09*	0.56	0.77	—
Y2006 (p-valuel)	0.84	0.81	0.26	0.63	0.65	0.12	—
Number of firms	180	179	179	174	174	174	174
No. of observations	891	886	886	763	763	763	763

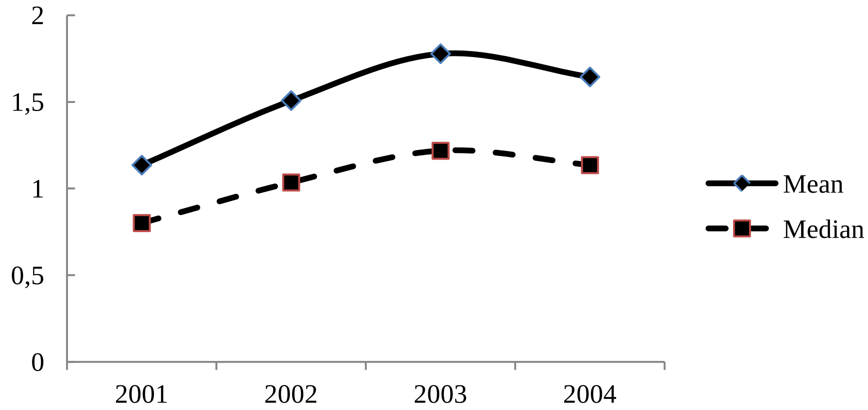
TABLE 5

Impact of post-2005 funding requirements: investment equation

The table presents the results for the two-step GMM-system estimation in a fixed effect panel data model using PcGive. Variables are scaled by end-of-year total book value of assets (*A*) where applicable. *I* are the firm's investment expenditures, *CF* is non-pension cash flows, *cgr* is capital gearing ratio, *br* is the borrowing ratio, *Q* is Tobin's *Q*, *S* is total sales and *PC* is the firm's pension contributions. T_{2005} is a time dummy set to be 0 for observations before 2005 and 1 in and after 2005. Specification (1) considers only the effect of pension contributions. In Specification (2) the pension funding status is used as a control for its correlation with unobserved investment opportunities. Specifications (3) the funding status control is underfunding and overfunding, separately. Specifications (4) to (6) use T_{2005} and T_{2005} × $(PC/A)_{it-1}$ as the time and group controls in the regression. The sample data range from fiscal year 2000 to 2007 and p-values for the time dummies of year 2004 to 2007 are reported. Asymptotic robust stand errors are reported in parenthesis. *, **, *** stand for 10%, 5% and 1% significance levels, respectively. The regressions use both contemporary and lagged independent variables but only results for the latter are reported to save space.

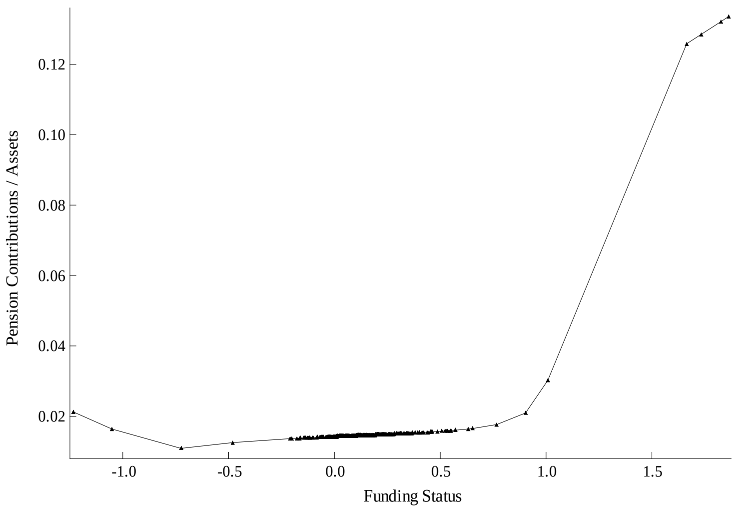
	Dependent variable: Investment$_{it}$ / A_{it}						
Specifications	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
$(I/A)_{it-1}$	0.082	0.099	0.172*	0.071	0.154**	0.141*	0.142*
	(0.076)	(0.074)	(0.090)	(0.074)	(0.074)	(0.084)	(0.080)
$(I/A)_{it-2}$	-0.011	-0.011	0.116	-0.006	0.147	0.092	0.091
	(0.075)	(0.074)	(0.089)	(0.075)	(0.095)	(0.093)	(0.096)
$(S/A)_{it-1}$	-0.044***	-0.038***	-0.006	-0.043***	-0.012	-0.036***	-0.039***
	(0.011)	(0.010)	(0.011)	(0.009)	(0.008)	(0.008)	(0.009)
$(CF/A)_{it-1}$	-0.114	-0.177	-0.131	-0.074	0.002	-0.214**	-0.193*
	(0.133)	(0.137)	(0.123)	(0.139)	(0.091)	(0.106)	(0.110)
cgr_{it-1}	-0.003	-0.004*	-0.006***	-0.004*	-0.006**	-0.004	-0.005
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
br_{it-1}	-0.001	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Q_{it-1}	0.030***	0.030***	0.008	0.032***	0.009	0.023**	0.027***
	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.009)	(0.010)
$(PC/A)_{it-1}$	-0.197	-0.204	-0.315**				
	(0.162)	(0.161)	(0.132)				
Fundingdummy $_{it-1}$ × $(PC/A)_{it-1}$				-0.296	-0.539**	1.582***	1.475**
				(0.217)	(0.220)	(0.535)	(0.742)
$(Funding\ status/A)_{it-1}$		-0.040					
		(0.041)					
$(Overfunding/A)_{it-1}$			0.042		0.033		
			(0.112)		(0.096)		
$(Underfunding/A)_{it-1}$			0.153***		0.131**		
			(0.056)		(0.052)		
T_{2005}							0.059**
							(0.027)
Fundingdummy $_{it-1}$ × T_{2005} × $(PC/A)_{it-1}$						-1.816***	-1.686**
						(0.586)	(0.795)
Y2003 (p-valued)	0.92	0.22	0.02**	0.79	0.06*	0.32	—
Y2004 (p-valued)	0.57	0.09*	0.38	0.54	0.64	0.78	—
Y2005 (p-valued)	0.41	0.68	0.13	0.65	0.19	0.11	—
Y2006 (p-valued)	0.60	0.54	0.65	0.39	0.91	0.22	—
Number of firms	171	171	171	171	171	171	171
No. of observations	700	700	700	698	698	698	698

Figure 1. Pension contributions over time



The graph reports the mean and the median values of pension contributions divided by total assets between 2001/02 and 2004/05 for all 164 FTSE350 firms with defined benefit pension schemes. Both mean and median are expressed in percentage values.

Figure 2. Kernel regression of pension contributions on funding status



This graph reports the results for Epanechnikov kernel smoothing using pooled data of pension contributions and pension funding status for 164FTSE350 firms with defined benefit pension schemes from 2001/02 to 2004/05. Funding Status is calculated as the ratio of pension deficit to total assets and hence negative values reflect overfunding and positive values reflect underfunded schemes.

Figure 3. Composition of the assets and liabilities of DB pension schemes

Pension Assets (*PA*)	**Pension Liabilities (*PL*)**
Opening fair value of scheme assets	**Opening DB pension liabilities**
(+) Return on the scheme assets (*ROA*)	(+) Pension service cost (*PSC*)
(+) Pension contributions (*PC*) (employer and employee contributions)	(+) Pension interest cost (*PIC*) (+) Other cost
(–) Benefits paid	(–) Benefits paid
Closing fair value of scheme assets	**Closing DB pension liabilities**