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The impact of 'A-day' on executive pensions and pay for performance

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This paper evaluates the impact of the 'A-day' pensions simplification legislation introduced in the UK in 2006. This reform exogenously affected the cost of pension provision for firms whose executives had accumulated pensions benefits in excess of the prescribed limit. We find a strong reaction in the form of pension provision in a sample of UK executive directors. After A-day, many executives saw their defined benefit scheme replaced with supplementary cash payments. This had the unintended consequence of significantly decreasing the relationship between executive pay and firm performance for those executives affected by the reform.

JEL codes: J32 J33 M12 M52

Key Words: Executive compensation; Executive pensions; Pay for Performance; A-day

1 Introduction

> Any work on executive compensation that uses compensation figures not including retirement benefits should recognize that it is ignoring a significant component of executive pay
>
> Bebchuk & Jackson 2005, p.36

Since the onset of the financial crisis, public interest in executive remuneration has intensified. In part this reflects concerns at the increasing dispersion in income and associated with trade and technological change and the returns to capital ownership (Piketty, 2014). But more

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specifically, the receipt by private firms, particularly high-paying financial firms, of substantial state support has provided a new mandate for the public scrutiny of executive pay and how risk-taking is rewarded. Moreover, there is an on-going unease that the worldwide trend towards greater transparency and accountability in corporate governance, a movement that started with the Cadbury report in the UK in 1991, has seemingly failed to halt the relative and absolute growth in executive rewards.

A major omission in the compensation literature is the size and form of executive pensions despite the fact they have received scrutiny in the US (Bebchuk and Jackson, 2005). An understanding of the pension element of executive remuneration is critical for a fully informed public debate. An important issue in this regard is the relation of pensions with company performance. The pay-performance relation has received a lot of attention and represents the benchmark in testing competing theories in corporate governance (Jensen and Murphy, 1990; Hall and Liebman, 1998; Conyon and Murphy, 2000; Conyon et al., 2011; Bell and Van Reenen, 2013; Gregory-Smith, 2012; Gregory-Smith and Main, 2014). Yet, none of these studies contain information on executive pensions. This is probably because, until recently, pensions benefits have not been disclosed with sufficient clarity to permit comparison between companies on a consistent basis over time. However, pension benefits are likely to impact not only on total reward but also on the pay-performance relation in ways which are not immediately obvious. First, since pension benefits are deferred until retirement, they provide an element of long-term lock-in with the company and increase the incentive for longer run decision making. However, the levels of pension benefits are typically tied to salary payments, whether as defined contributions or defined benefits, and salary is paid irrespective of performance. Thus, the overall impact of pensions on individual incentives and firm performance is unclear.

An analysis of the impact of recent changes in legislation relating to pensions also offers the opportunity to examine the impact of exogenous changes on remuneration where previously the endogenous nature of the pay-performance relation has confounded its estimate. The structure of CEO's pay contract and how performance is rewarded are the result of negotiations between the CEO and the firm's remuneration committee. The fact that estimates of the pay-performance relation have sometimes been lower than expected (Jensen and Murphy, 1990) might be attributed to an inability to observe the firm's desire to provide insurance for its executives (Garen, 1994)[6]. An advantage of this study over the prior literature is that it exploits the introduction of pensions 'A-day' in April 2006. This natural experiment exogenously affected executive pension provision and provides a control group since in our sample of UK executives some are affected by A-day and others are not. This allows us to estimate the pay-performance relation for both the treated and untreated groups of executives, before and after the introduction of A-day. We also examine a subsequent reform to the A-day rules in April 2011.

[6] Albeit more recent estimates report a larger pay-performance relation as discussed below.

2 Literature

2.1 Executive Pensions

Bebchuk and Jackson (2005) represents the first attempt to document executive pension benefits. The authors established that pensions are a significant part of the executive remuneration package in the US with a median value of $15M amongst retiring S&P500 CEOs in 2003/4. They argue that executive pensions, being sizable and opaque, are a device used by the executives to inflate their total pay without attracting outrage from outsiders who might otherwise constrain their pay. In other words, pensions are stealth payments, consistent with the (Bebchuk and Fried, 2003) 'managerial power' thesis that the CEOs have captured the pay-setting process.

The leading alternative view to Bebchuk and Jackson (2005) is put forward by Sundaram and Yermack (2007) who argue that executive pensions are part of an optimal contract, constrained by market forces. It is argued that pensions, because they are 'inside debt', can be used to align managerial interests with those of bondholders. While employee defined benefit pension funds in the UK are insured by the Pension Protection Fund (Goh and Li, 2015), a typical executive's pension far exceeds the insured amounts (which range from £18,000 to £36,000 subject to the employee's age). A CEO, who is sitting on a multi-million pension, stands to lose nearly all of it if they take risks that result in bankruptcy [7]. Sundaram and Yermack (2007) show, in a sample of 237 US CEOs, those with large defined benefit pensions behave more conservatively. An objection to this view is that equity payments to CEOs, in the form of stock options, may act in the opposite direction and provide CEOs with incentives to undertake risky projects. It seems counterintuitive that firms provide their CEOs simultaneously with sizeable amounts of both equity and inside debt, suggesting that pensions may play some other role than aligning managerial interests with those of bondholders. A second objection with the Sundaram and Yermack (2007) finding, is that they do not attempt to establish a causal relationship between inside debt and the level of risk taking by CEOs. Hence an alternative explanation for their finding is that the association between conservative behaviour and pension entitlement is simply a function of an ageing CEO or a maturing market.

To address these objections, Edmans and Liu (2011) provide a formal theoretical model showing that the use of pensions as inside debt alongside the use of equity payments can be optimal in several settings. This is because, while equity payments provide risk-shifting incentives, pensions make the manager sensitive not just to bankruptcy but also to the value of the firm in the event of bankruptcy. This is also consistent with empirical evidence from Wei and Yermack (2011) who provide evidence on the use of pensions as inside debt, specifically allowing for inside equity claims and distinguishing between defined benefit schemes (where the risk of

[7] Albeit that in practice a company might honour its pension obligations before those to other creditors

default is borne by the CEO) and defined contribution schemes where the CEO's pension pot is secure in the event of bankruptcy.

Further evidence on the impact of pensions on CEO behaviour is given by Anantharaman et al. (2013) who find that executive pensions lead to lower loan yields and fewer covenants. An innovative feature of their study is the use of US state-specific income tax rates to instrument for CEO's inside debt position based on the logic that higher income tax rates provide a stronger incentive for executives to receive deferred payments. Their result is driven by benefits accrued under 'supplemental executive retirement plans' (SERPS). These are forms of executive pensions more closely resembling inside debt, as they are typically unfunded and hence not secured in the event of bankruptcy.

A UK based study is Kabir et al. (2013) who investigate the extent to which executive compensation affects the cost of debt. They look at CEO compensation in UK companies over the period 2003-2012. They find that firms using more intensively defined benefit schemes to reward CEOs have lower costs of debt as measured by the company's bond spread. This provides indirect evidence for the notion that defined benefit schemes are an instrument to align CEO's interests with those of the bondholders. Using US data, Cassell et al. (2012) explicitly test whether firms in which CEOs are paid with inside debt are run more conservatively. They use the future stock return volatility of the company as a measure of a CEO risk-seeking behaviour and find that CEO's debt-to-equity ratio is negatively associated with future stock volatility and that this negative relationship can be explained by a more conservative investment behaviour. When CEOs have higher debt-to-equity ratios the firm invests less in R&D and diversifies its economic activities.

A recent paper by Goh and Li (2015) presents evidence on the pensions of FTSE100 executives between 2004 and 2011 to suggest that pensions act as a substitute for performance based pay. Since such behaviour is seen to occur more intensively in companies with weaker corporate governance controls, the authors interpret this finding as evidence for the Bebchuk and Jackson (2005) view of pensions as stealth compensation. One difficulty with this interpretation is that the corporate governance variables used to proxy the strength of monitoring may be endogenous with respect to compensation design (Hermalin and Weisbach, 2003). Monitoring and pensions may be negatively related not because of managerial power but because decisions on monitoring, pensions and performance pay have been taken simultaneously. In the absence of any exogenous variation in these variables it is hard to discern between the competing interpretations.

3 Reform of UK Pension Legislation

April 2006 saw the introduction of a major reform to UK pensions (known as "A-Day") designed to combine eight distinct sets of pension legislation into one simpler system. The main feature of the legislation was the introduction of annual and lifetime allowances. These allowances were caps on the amount of pension which could benefit from tax relief[8].

Table 1 shows the annual and lifetime allowances for each tax year following A-Day (pensions over these limits do not benefit from tax relief). From A-Day until the 2010 tax year the annual allowance increased by £10,000 from an initial £215,000. This then fell considerably to a £50,000 cap from 2011 onwards, with a further reduction to £40,000 from 2014. Similarly, the lifetime allowance increased incrementally for the first five years following the reform, from £1.5 million to £1.8 million, but was then reduced between 2011 and 2014 to £1.25 million.

Table 1: Pension Allowances

Tax Year	Annual Allowance	Lifetime Allowance
April 2006	£215,000	£1.5 million
April 2007	£225,000	£1.6 million
April 2008	£235,000	£1.65 million
April 2009	£245,000	£1.75 million
April 2010	£255,000	£1.8 million
April 2011	£50,000	£1.8 million
April 2012	£50,000	£1.5 million
April 2013	£50,000	£1.5 million
April 2014	£40,000	£1.25 million

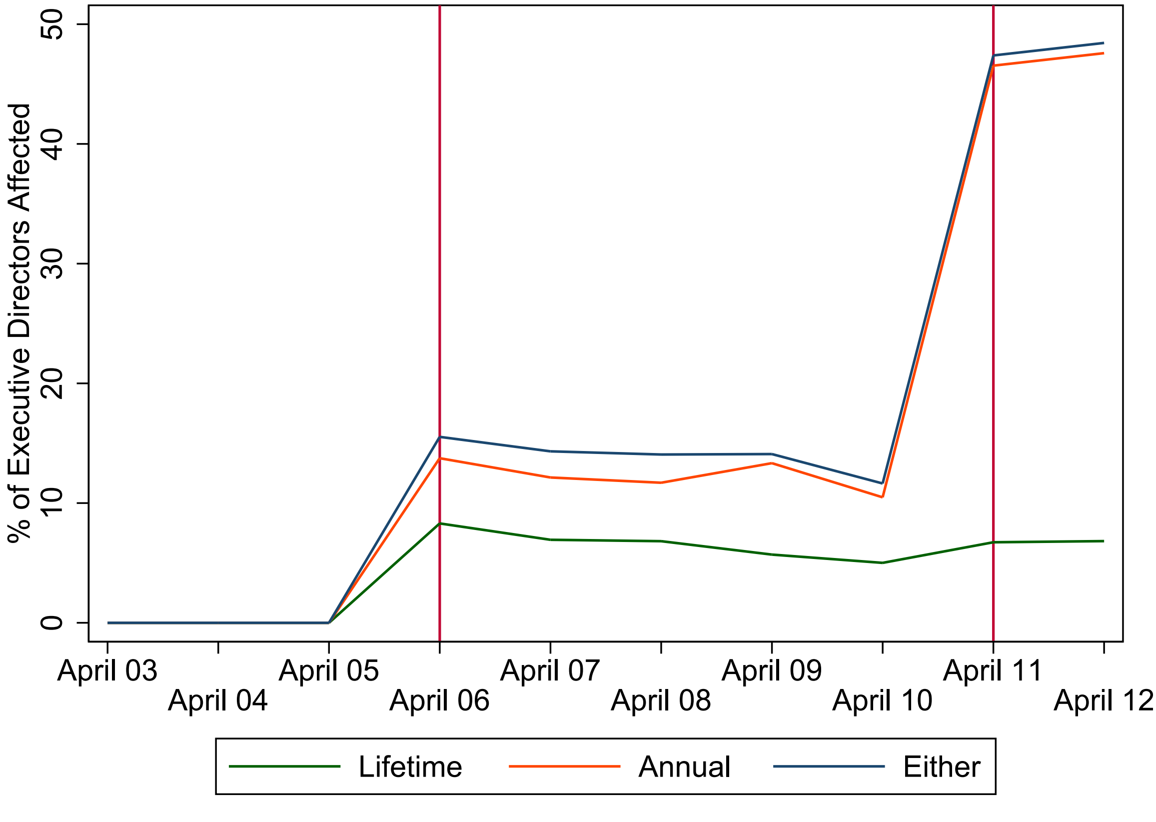
1. The UK tax year runs from 6th April to 5th April the following year. Directors' payments for the year are disclosed as at each company financial year-end. Therefore, if the company's financial year-end is on or after the 6th April 2006, the pension payments in our data are subject to the allowances.

In the case of the annual allowance, any pension payments in excess of the cap are subject to taxation. Likewise, breaching the lifetime allowance results in additional taxation when the pension comes to payment. If the total value of the pension pot exceeds the allowance then the excess pension is subject to a surcharge of 25%. Given that individuals who earn enough to breach the lifetime allowance are highly likely to be in the 45% tax bracket, this amounts to a 58.75% tax on pensions in excess of the allowance. A 58.75% tax rate also applies to the part of any lump sum payment which is in excess of the allowance.

Figure 1 gives an indication of how many executives in the FTSE350 have been affected by

[8] In December 2004, a Government White Paper was published which contained the outline of the proposals that became A-day. In our analysis we looked for evidence of anticipation of the pension tax allowances by companies during the data collection phase. In some financial statements for 2005 we found reference to the pending changes but it did not appear to be the case that this was acted upon until the year in question. The most likely explanation for this is that remuneration policy is reviewed annually, first being set by an independent committee and then voted upon by shareholders at the Annual General Meeting and so subject to inertia.

Fig. 1: Percentage of Executives Affected by Pension Cap



1. The figure shows the proportion of executive directors in our sample that were affected by the introduction of A-day in 2006 and the subsequent changes to the allowances.

the reforms to the pension system. It shows that with the initial introduction of the £215,000 annual allowance and £1.5 million lifetime allowance around 15% of executives were caught by one of the two allowances, with the annual allowance catching more executives than the lifetime allowance.

The subsequent modest changes to the allowances between 2006 and 2011 did not further impact on the percentage of executives directly affected. However, the significant tightening of the annual allowance effective from April 2011 had a large effect, with an approximate 35% points increase in those affected to almost half of all executive directors in the sample.

4 Data

The dataset used in this study is based on executives in 794 companies listed on the London Stock Exchange with a financial year end between 1 January 2003 and 31 December 2012 (inclusive). Manifest Information Services Ltd have collected pensions information since 2006. In order to capture trends prior to A-day, we backfilled the pensions information to 2003 by purchasing companies' annual report and accounts which are archived at Companies House.[9]

Our sample period covers the three years prior to A-Day and includes both the introduction of the allowances at A-Day and the substantial reduction of the annual allowance in April 2011. The sample is restricted to executive directors until they reach retirement, age resulting in a panel dataset of 21,687 executive-firm-years.

4.1 Variables

The key variables of interest are the executives' pension benefits and total direct compensation (TDC). TDC is constructed as the summation of salaries, bonuses, long term incentive plans (LTIP's), stock options, pensions, and other perquisites. Options and LTIPs are valued at grant date. As we have precise appointment and resignation dates we are able to annualise the pay of executives who did not serve a full financial year.

Data is available for the annual pension contribution under three types of pension scheme; defined benefit, defined contribution, and cash salary supplements in lieu of pension. Defined contribution and cash-in-lieu payments are defined simply as the payments made by the firm to an executive's pension arrangement or as a salary supplement as stated in the annual report and accounts.

[9] 22 company-years were dropped because we could not find any pensions information, i.e., the pension benefits were missing rather than disclosed as zero.

Since defined benefit pensions pay an annual sum based on an executive's salary and length of service on retirement, an annual valuation for this type of pension scheme is less straightforward. Companies are required to disclose the transfer value which represents the total cost to the company of the pension liability. It is calculated by taking the change in the transfer value and since this captures the cost to the company it is the best measure of annualising the defined benefit entitlement, though imperfect. It is an imperfect measure, firstly because market movements influence the figure and in extreme cases cause it to be negative. Secondly, it does not necessarily equal the value that the executive would place on that additional year of service.

Director level control variables include age, tenure, gender, and position on the board. Other key variables include firm performance, measured as total shareholder return (TSR). TSR is the annual change in the log of the return index supplied by Datastream. We also have information on firms' sales revenues which we use as a proxy for firm size. Variation in corporate governance is captured using variables for board size, the percentage of non-executive directors on the board who are considered independent, joint CEO/Chairmanship, and institutional ownership.

4.2 Descriptive Statistics

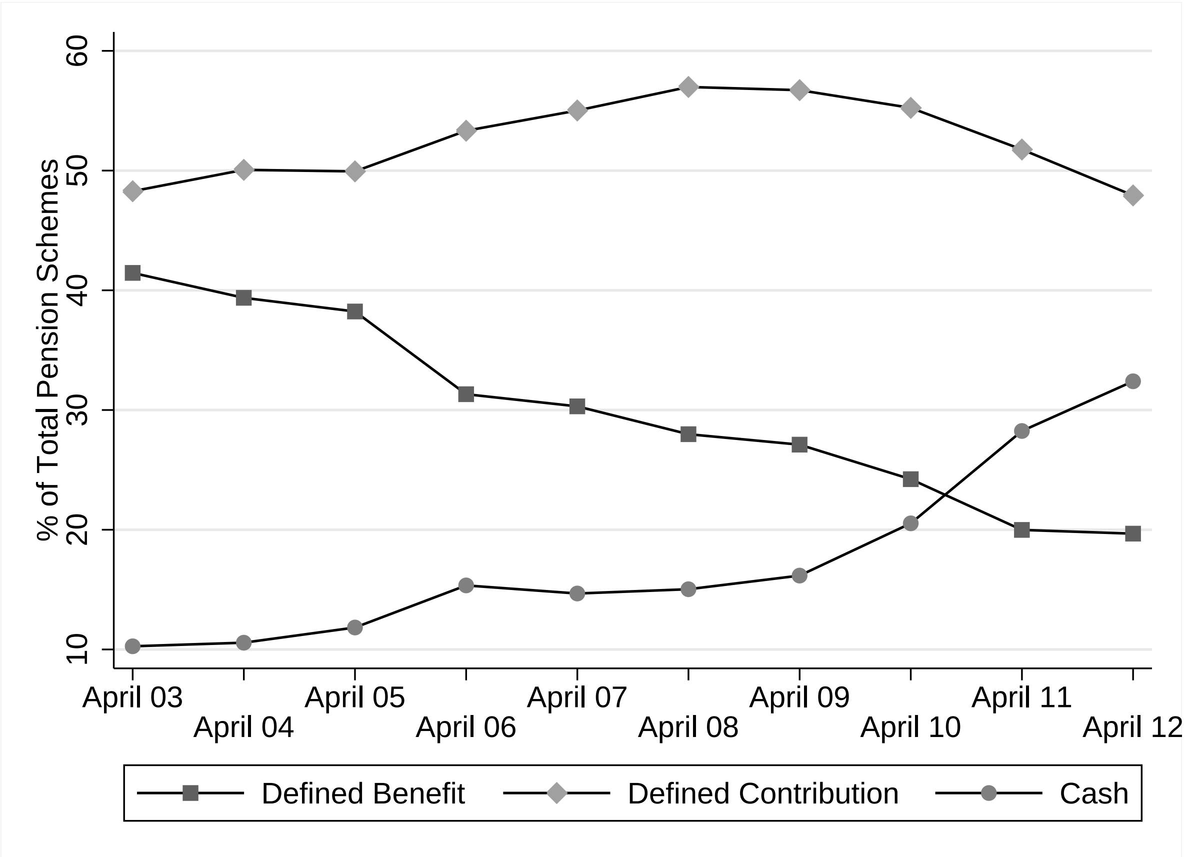
The movements in the distribution of pension arrangements over time are shown in Figure 2. One key feature is the shift away from defined benefit schemes, which fall from 40% of total executive pension schemes to 20% between the 2003 and 2012 tax years. This is matched by a steady increase in the proportion of cash supplements which increase by 20% points from 10% to just over 30%, becoming more prevalent than defined benefit schemes after 2010.

There are indications that pension reform has influenced these trends. Despite the pre-existing decline in the popularity of defined benefit schemes[10] there is a noticeable drop around A-Day of almost 10% points between the 2005 and 2006 tax years. Initially, defined contribution schemes increased in prevalence after A-Day but after 2009 begin to decline, at which point an upswing in cash-in-lieu payments took place. The increase in the use of cash salary supplements is particularly noticeable after 2010, when the annual allowance was substantially reduced.

Figure 3 shows the mean pension over time by scheme. The most striking feature of this figure is the generosity of defined benefit schemes compared to defined contributions or cash payments. Prior to A-Day the mean annual defined benefit pension was more than triple the

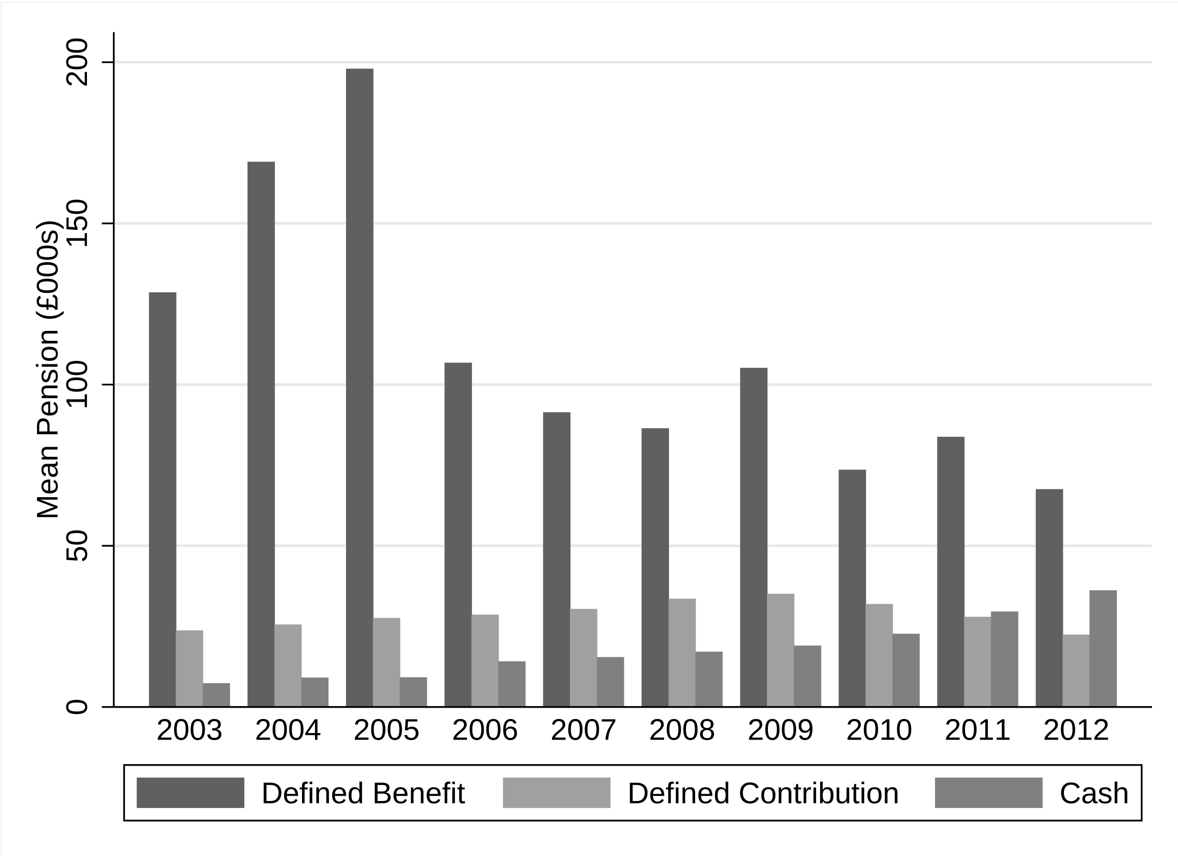
[10]By 2003 defined benefit pension schemes were being replaced by many companies and were being closed to new entrants, with only incumbent executives accruing benefits. The steady decline in the proportion of defined benefit schemes partly reflects executives switching firms and being unable to access defined benefit schemes in their new firm.

Fig. 2: Distribution of Pension Scheme Type



1. The figure shows the three forms of retirement provision for executives in our data. A defined benefit scheme provides for a fixed income in retirement, usually a proportion of final salary, subject to a number of years service. A defined contribution is a sum of money, typically a percentage of current salary, placed by the company into trust, which upon retirement can be converted into an annuity. Cash is compensation paid directly to the executive in lieu of any other retirement benefits.

Fig. 3: Mean level of employer pension contributions over time



1. The figure shows the mean annual pension payments over time by each type of retirement provision. Defined benefit schemes are valued higher than defined contribution or cash payments, albeit the gap has closed over time and, in particular, after the introduction of A-day in 2006.

value of either of the other two types of pension provision. The impact of A-Day appears to have been substantial, halting the year-on-year increase in the mean value of defined benefits, and reducing its value by almost £100,000 in the year immediately following implementation.

The mean value of defined contribution scheme payments continued to steadily increase after A-Day, reaching a peak in 2009 before declining. The mean cash payment in lieu of pension has consistently increased over time, exceeding the mean of defined contribution schemes after 2011. The average defined benefit is still larger than both defined contributions and cash payments but this gap has narrowed substantially over our sample period and in particular since A-Day.

5 Pension Reform and Executive Pension Provision

Having provided some descriptive analysis in this section we model the amount of pension payment and the pension scheme to assess how it varies with the characteristics of the executives. Having identified the determinants of pension provision we then estimate difference in difference models to investigate the impact of A-Day on the pension arrangements of executives.

5.1 Determinants of Pension Provision

Table 2 presents results for the intensive and extensive[11] provision of pensions. The first four columns are intensive models of, respectively, total pensions, defined benefit pensions, defined contributions, and cash in lieu of pension contributions. For the intensive margins (p), the dependent variables are $log(p+1)$ in order to retain zero observations. The intensive margin models are then estimated using a random effects Tobit model. The final four columns report the analogous models for the extensive margin where the probability of receiving a pension scheme type is modelled using a random effects probit.

[11]The extensive model analyses changes in the incidence of each type of pension arrangement, whereas the intensive model analyses changes in the values of each pension type (Blundell et al., 2013)

Table 2: Models of Pension Provision

	Intensive				Extensive			
	ln(Pension)	ln(DB)	ln(DC)	ln(Cash)	Pension	DB	DC	Cash
Log(Sales)	0.604***	2.879***	-0.337***	2.701***	0.152***	0.938***	-0.120***	0.364***
	(12.45)	(19.84)	(-4.14)	(12.68)	(6.35)	(7.82)	(-4.57)	(9.95)
Age	1.371***	2.451***	1.498***	0.263	0.516***	0.733***	0.402***	0.073
	(14.59)	(10.88)	(9.58)	(0.66)	(9.55)	(5.88)	(6.32)	(0.86)
Age^2	-0.014***	-0.021***	-0.018***	-0.004	-0.006***	-0.006***	-0.005***	-0.001
	(-15.23)	(-9.40)	(-11.14)	(-0.98)	(-10.11)	(-5.19)	(-7.28)	(-1.05)
CEO	0.795***	0.449	0.503**	2.429***	0.241***	0.074	0.075	0.372***
	(6.51)	(1.60)	(2.50)	(5.07)	(3.75)	(0.62)	(1.06)	(4.43)
TSR	0.241***	0.550***	0.381***	0.001	0.132***	0.170***	0.131***	-0.002
	(3.32)	(3.03)	(3.58)	(0.00)	(3.65)	(2.72)	(3.65)	(-0.05)
σ^{TSR}	-0.321**	-1.602***	0.723***	1.456**	-0.206**	-0.640***	0.180*	0.241*
	(-2.07)	(-4.09)	(3.02)	(2.25)	(-2.43)	(-3.26)	(1.87)	(1.88)
FTSE100	1.455***	1.395***	-0.608*	1.023	0.563***	0.427*	-0.192	0.266*
	(6.73)	(2.96)	(-1.66)	(1.31)	(4.80)	(1.90)	(-1.46)	(1.78)
FTSE250	1.071***	1.347***	0.464**	2.505***	0.557***	0.445***	0.134*	0.439***
	(8.48)	(4.35)	(2.37)	(4.96)	(8.19)	(3.04)	(1.89)	(4.35)
% IC Owned	0.019***	0.020***	0.019***	0.006	0.011***	0.007**	0.008***	0.001
	(6.23)	(2.95)	(3.90)	(0.49)	(5.88)	(2.55)	(4.27)	(0.31)
% Independent NED's	0.690**	-1.230*	2.432***	-0.250	0.586***	0.103	0.886***	-0.078
	(2.21)	(-1.69)	(5.04)	(-0.19)	(3.31)	(0.30)	(4.85)	(-0.32)
Board Size	-0.072***	-0.044	-0.195***	-0.085	-0.038***	-0.033*	-0.058***	-0.013
	(-3.70)	(-1.03)	(-6.19)	(-1.10)	(-3.47)	(-1.83)	(-5.22)	(-0.89)
Leverage	-0.018	1.729***	-0.523*	1.682*	-0.025	0.646***	-0.243**	0.217
	(-0.09)	(2.97)	(-1.76)	(1.86)	(-0.26)	(2.81)	(-2.30)	(1.37)
Observations	19316	19316	19316	19316	19316	19316	19316	19316
Censored	3913	13486	9610	16312				
Uncensored	15403	5830	9706	3004				

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$,
All models include executive-firm random effects, time dummies, and industry dummies. Intensive models are estimated using random effects Tobit. Extensive models are estimated using random effects probit. Dependent variables in each of the intensives cases are transformed as log(pension+1).

Explanatory variables in both types of model include the log of sales to proxy firm size, the executives age, a dummy indicating whether the executive is a CEO, a dummy indicating whether the executive is employed by a FTSE100 firm, and TSR to measure firm performance. In order to capture risk and uncertainty in firm performance we also include a performance volatility variable. This is created as the standard deviation of firm performance over the most recent five financial years. To investigate the role of corporate governance in pension provision we also include the percentage of shares owned by investment companies, the percentage of independent non-executives directors (NEDs) on the board, and the total number of directors on the board.

Turning to the results, executive level variables have a differential effect on pension provision by type. Age has a positive effect on the receipt and level of overall pension and defined benefit/contribution pensions but has no significant effect on cash payments at either the intensive or extensive margins. CEOs are more more likely than non CEOs to have a pension overall and their pension benefits are larger. However, CEOs are not systematically more likely to have a defined benefit or defined contribution scheme than non CEOs although they are more likely to be in receipt of a cash supplement in lieu of pension.

Firm characteristics also play an important role in determining the intensive and extensive provision of pensions. Both the probability of receipt and size of pension are positively associated with firm size. The exception to this is defined contribution pensions, for which firm size has a significant negative effect on both probability of receipt and level. Better performing firms pay more pensions and are significantly more likely to provide each type of scheme, with significant coefficients for TSR at the 5% level in all but the cash-in-lieu models. The volatility of TSR (holding TSR constant) is seen to coincide with a reduction in the use of defined benefit schemes but greater use of defined contributions and supplementary cash payments. This is consistent with the notion of defined benefit schemes (typically unfunded) functioning as inside debt, with executives seeking to avoid exposure to bankruptcy that comes with more volatile firm performance. Defined contributions, by contrast, are typically funded schemes with monies held in trust and available for payment in the event of bankruptcy. Hence, their schemes are preferred to the extent that executives can anticipate the volatility of the firm's stock *ex ante*, along with cash payments that also carry no exposure to bankruptcy.

Institutional ownership has a small but statistically significant positive effect on both the level and provision of defined benefit and defined contributions. To the extent that institutional ownership proxies for monitoring intensity, this is inconsistent with the managerial power view of stealth payments being easier to secure in less tightly monitored firms. Likewise, the independence of the non-executive directors is associated with a positive overall effect on the level and provision of executive pensions, albeit with a small negative effect with respect to defined benefit schemes. Larger boards of directors, which are perhaps less effective at monitoring (Yermack, 1996), are associated with a lower probability of pension receipt and amount, with no significant effects found for defined benefit schemes or provision of cash. Together, these proxies of corporate governance effectiveness suggest that managerial rent extraction is unlikely to be at the heart of pension provision. If anything, corporate governance effectiveness appears to correlate with greater pension provision.

We also include a number of other executive level and firm level control variables. There is some heterogeneity in the affects these variables have on different types of pension scheme, with larger firms being more likely to provide defined benefit schemes or pay cash supplements but significantly less likely than smaller firms to use defined contribution schemes. Older executives, CEOs, and those in better performing firms have larger pensions. We control for these features of the data directly in subsequent analysis.

5.2 Difference in Difference Analysis

We now examine the impact of both A-Day and the 2011 reduction in the annual allowance to £50,000 on both pension provision and pension generosity. To do this we define three treatment effects; the effect of A-Day on those executives who were directly affected by it, the effect of the 2011 reduction on that same group of executives, and the effect of the 2011 reduction on any executive who had previously received a pension greater than £50,000 but was not affected by A-Day.

Table 3: Treatment and Control Groups

Variable Name	Treatment Definition	Control Definition
Treatment/control groups for A-Day:		
Treated 2006	Executives who exceeded the lifetime allowance or the annual allowance prior to A-Day	Executives who did not exceeded either allowance prior to A-day
Treatment/control groups for 2011:		
Treated 2006*	Executives who exceeded the lifetime allowance or the annual allowance prior to A-Day	Executives who never exceeded either allowance
Treated 2011	Executives not affected prior to A-Day but who exceed the £50,000 annual allowance prior to 2011	Executives who never exceeded either allowance

* This allows us to separate the effect of the 2011 reduction in annual allowance on those already treated by A-day, from those not affected by A-day but affected by the 2011 reduction.

The model we estimate is:

$$
\begin{aligned}
y_{ijt} = \beta_1 Treat_i^{06} + \beta_2 Treat_i^{11} + \tau_1(Treat^{06} \times Post^{06})_{it} \\
+ \tau_2(Treat^{06} \times Post^{11})_{it} + \tau_3(Treat^{11} \times Post^{11})_{it} + \alpha' \bar{X}_{ijt} + \eta_{ij} + \epsilon_{ijt} \quad (1)
\end{aligned}
$$

In equation 1, the τ parameters denote estimates of the average treatment effect on the treated (ATT). τ_1 is the effect of A-Day on the treated executives, τ_2 is the effect of the 2011 reduction on those executives already treated by A-Day in 2006, and τ_3 is the effect of the 2011 reduction on those previously unaffected. y_{ijt} denotes the outcome variable: the total annual pension; the total value of the defined benefits; annual defined benefits; defined contributions; and cash-in-lieu; and the three binary variables indicating whether or not the executive receives defined benefits, defined contributions, or cash-in-lieu.

All models include in the control vector $\bar{X}$, a pre-treatment time trend for each treatment group, and the same vector of control variables used in the pension provision models; age, age squared, a CEO dummy, TSR, TSR volatility, board size, board independence, institutional ownership, and log sales. η_{ij} denotes the executive-firm fixed effects. Treatment effects for both extensive and intensive pension provision are estimated in a linear probability model with fixed effects. The dependent variables for the intensive models are ln(y+1) so that the estimated treatment effects have an approximate log-linear interpretation.

The results of this analysis are presented in Table 4. For parsimony, only the treatment effects themselves are reported (full results reported in the appendix). The first row shows that the main impact of A-Day was on the level and provision of defined benefit schemes. Relative to the control group, those affected by A-Day saw a large reduction in their annual defined benefit pension after A-day. With the dependent variable in log form the estimated coefficient is -1.54, which, at the mean, is equal to a reduction of approximately £360,000. However, defined contributions were not significantly reduced after A-day. The contrast between the two schemes is explained by the initial generosity of defined benefit schemes compared to defined contributions. That is, the tax thresholds introduced on A-day were such that, in the majority of cases, only those on defined benefit schemes would have been affected.

We also observe some executives switching out of defined benefit arrangements into cash supplements. Consistent with the descriptive statistics shown earlier, we estimate a 8% point reduction in the use of defined benefit schemes and a 5% point increase in the use of cash payments. However, the increase in cash payments (approximately £20,000 at the mean), is substantially less than the reduction in defined benefits. Given that we observe first hand from company financial disclosures that many companies used cash payments to compensate their executives for a loss of pension benefits after A-day, it is curious that the compensation appears to be fall a long way short of fully offsetting the loss in defined benefit pension provision. A possible explanation might be that the control group also started to receive cash payments around the same time, and so the difference-in-difference estimate understates the total amount of cash compensation. Another possibility could be because our specification controls for a separate linear trend for the treated and control group any cash payments awarded prior to A-day in anticipation of the introduction of A-day are absorbed by these trends and do not show up as treatment effects. A closer inspection of the estimated coefficients reveals that this explanation has some merit. We observe a positive and significant increase in the use of cash for both groups (approximately £8,600 per year), which accounts for some,

Table 4: Pension Reform Treatment Effects

	Intensive					Extensive		
	Pension	DB Total	DB	DC	Cash	DB	DC	Cash
Post 06 × Treated 2006	-1.23***	-0.67***	-1.54***	0.49**	0.68***	-0.05***	0.08***	0.06***
	(-5.29)	(-4.56)	(-6.16)	(2.15)	(3.25)	(-2.82)	(3.65)	(3.29)
Post 11 × Treated 2006	-1.20***	-0.60***	-1.51***	-0.35*	1.81***	-0.07***	-0.02	0.17***
	(-4.26)	(-3.09)	(-4.76)	(-1.66)	(5.97)	(-3.18)	(-0.95)	(6.11)
Post 11 × Treated 2011	-0.18	0.03	-0.19	-1.33***	2.32***	-0.01	-0.09***	0.22***
	(-0.94)	(0.33)	(-1.24)	(-5.41)	(8.97)	(-1.12)	(-4.24)	(9.12)
N	19330	19330	19330	19330	19330	19330	19330	19330
Director-Firms	4785	4785	4785	4785	4785	4785	4785	4785

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
All reported treatment effects obtained from fixed effects regressions controlling for executive-firm fixed effects. Control variable vector X contains; log(sales), CEO dummy, age, age squared, board size, percentage of independent directors, percentage investment firm owned, FTSE100 dummy, five year standard deviation of TSR, leverage, a linear time trend/treatment status interaction for both treatment levels, and time dummies. Intensive margin dependent variables are ln(1+y).

but not all, of the discrepancy.

The reform to the tax thresholds in 2011 also had a significant impact on pension arrangements. Those executives who were initially affected by A-Day were once again caught by the reduction in tax allowance. Additionally, some executives not effected in 2006, saw also reduction in their pension benefits in 2011. On the extensive margin, we see an additional exit from defined benefit schemes and an uptake of cash supplements. While on the intensive margin, the reduction in defined schemes is approximately equal to £267,000 at the mean. However, the 2011 reduction in annual allowance was such that even those on defined contribution schemes saw significant changes to their pension tax liabilities. Thus, we observe an increase in the use of cash supplements to offset this reduction by approximately £16,000 at the mean. Taken together, these results reveal that the pension reforms had a significant effect on executive pension provision.

6 Pension Reform and Pay-Performance

Given the evidence presented that A-Day had a significant impact on the level and type of pension provision, our next step is to examine whether this shock to executive pay structure impacted on the relationship between pay and firm performance. In the executive compensation literature, the pay-performance relation is the estimated coefficient β from the following equation:

$$y_{it} = \gamma_i + \alpha_t + \beta(Performance)_{it} + \lambda(X)_{it} + \mu_{it} \tag{2}$$

where y_{it} is CEO compensation in firm i and time t (usually in logs), γ_i is an unobserved time-invariant firm specific effect, α_t is a common time effect, $Performance$ is firm performance, most often measured by total shareholder return (which captures dividends and stock price growth) and X is a vector of firm level controls, such as firm size.

The size of β measures the extent to which CEO's pay varies with the returns to the principal's investment. That is, pay-for-performance. A higher level of β transfers risk from shareholders to the CEO. Given imperfect monitoring, a large and positive β provides economically meaningful incentives for the CEO by rewarding performance and punishing failure.

There is substantial variation in the estimates of the pay-performance relation over time, between industries and between different countries. Most of the key contributions to the literature draw on evidence from US companies, with the more recent studies finding that CEO pay has a robust relationship with company performance (Kaplan, 2008; Murphy, 2012).[12] In terms of the UK[13], the most recent estimates are Bell and Van Reenen (2013) and Gregory-Smith and Main (2014). Bell and Van Reenen (2013) examine the relationship between pay and performance across all levels of the corporate hierarchy. They combine a number of data sources (Boardex, Towers Watson, Annual Survey of Hours and Earnings (ASHE) and the Annual Respondents Database (ARD)) in order to obtain information on the pay of all workers as well as executives. The sample is a panel dataset of the 300 largest publicly listed UK firms between 2000 and 2010, resulting in 498 firms, 439 of which are matched with executive pay data. The dependent variable is total compensation measured as the sum of salary, cash bonuses, stock options, long term incentives (but not pensions). Performance is measured by total shareholder return (TSR). They find a pay-performance sensitivity of between 0.173 and 0.248. There is also some evidence of asymmetry in the relationship; that is, executives are rewarded for good performance to a greater extent than they are penalised for poor performance.

Gregory-Smith and Main (2014) analyse the pay-performance relation over the careers of executive directors. Total realised compensation is the measure of pay used, but again they do not have information on pensions. A positive pay-performance relation over the executive's career is found and consistent with Bell and Van Reenen (2013), this is driven by those who create value for their companies over their career $\beta = 0.17$ as opposed to those who destroy value $\beta = 0.06$. In addition, a 'settling-up process' (as in Fama (1980)) is revealed, whereby pay is adjusted in light of new information regarding the previous performance.

Having established a base framework for measuring pay-performance sensitivity, we examine

[12] The pay-performance literature is vast and a full review is not attempted here. Reviews are provided by Murphy (1999); Prendergast (1999); Frydman and Jenter (2010); Kaplan (2012).

[13] Pay levels for the CEO are lower in the UK, even after controlling for firm size (Conyon and Murphy, 2000; Conyon et al., 2011). UK executives typically hold less stock and incentive-based elements and operate inside a 'comply or explain' regime, whereby compliance with documented 'best practice' (FRC, 2014) is expected and non-compliance must be explained to shareholders.

how A-day affected β, for our treated and control groups. Equation (3) extends the model to allow for these effects by interacting the treatment dummy, post-reform dummy, and performance as follows:

$$\begin{aligned} log(pay)_{ijt} = \beta_1 Treat_i^{06} + \beta_2 Post06_t + \beta_3 TSR_{jt} \\ + \beta_4 (Treat^{06} \times Post06) + \beta_5 (Treat^{06} \times TSR) + \beta_6 (TSR \times Post06) \\ + \beta_7 (Treat^{06} \times Post06 \times TSR) + \alpha' \bar{X}_{ijt} + \eta_{ij} + \epsilon_{ijt} \quad (3) \end{aligned}$$

The estimates of the relevant β coefficients in equation 3 are presented in Table 5 for five different specifications. The first two columns report results for specifications which omit the other control variables. The third column reports the coefficients when the control variables are added with fixed effects. The fourth adds a differential time trend for the treatment group, and the fifth includes interactions with TSR and the 2011 reduction treatment variables (none of these interactions are statistically significant and are not reported). The fixed effects specifications are consistent with each other and estimate a negative impact of A-day on the pay-performance sensitivity of the treated group relative to the control group of approximately 20 percentage points. Given there are strong reasons for preferring the fixed effects specifications, (namely unobserved executive-firm level fixed effects), we consider this credible evidence of an unintended negative impact of A-day on pay-performance sensitivity.

Table 6 shows how the estimated parameters of this model can be used to calculate the pay-performance sensitivities for each group and estimate the impact, of A-Day on the treated executives. The sensitivities reported correspond to those of the fixed effects parameter estimates with the control variables included. The pay-performance sensitivity of the treated group is substantially larger than that of the control group prior to A-Day at 0.24 compared to 0.03.

The treated group have a post A-Day pay-performance elasticity of approximately 0.08 while the untreated group's is 0.07. After A-Day the control group's elasticity increases by 0.05 while the treated group's falls by 0.16. The difference-in-difference of the pay performance sensitivity therefore reflects the fact that the sensitivity increased for the untreated executives and decreased for the treated. Both of these differences are independently significant at the 5% level and the overall difference-in-difference of -0.21 is significant at the 1% level.

We therefore find evidence which suggests the reforms to UK pension legislation implemented in 2006 have had adverse effects on the incentives of the affected executives of UK firms. While A-Day has had an impact on the most generous executive pension packages, these results indicate that these pensions may have constituted part of an optimal incentives contract in which executives with particularly generous pension arrangements were motivated

Table 5: Effect of Pension Reform on Pay-Performance Sensitivity

	OLS	Fixed Effects			
	Raw	Raw	+Controls	+Trend	+2011
TSR	0.11***	0.04**	0.03	0.03	0.04*
	(4.43)	(2.07)	(1.38)	(1.41)	(1.79)
Post 06 × Treated 06	-0.09**	-0.02	0.01	-0.14***	-0.22***
	(-2.08)	(-0.53)	(0.45)	(-3.64)	(-5.63)
Treated 06 × TSR	-0.08	0.20***	0.23***	0.21***	0.18***
	(-1.41)	(3.87)	(4.51)	(4.16)	(3.45)
Post 06 × TSR	0.03	0.05**	0.05**	0.05**	0.05**
	(0.98)	(2.50)	(2.13)	(2.13)	(2.25)
Post 06 × Treated 06 × TSR	0.06	-0.19***	-0.23***	-0.21***	-0.20***
	(0.73)	(-3.10)	(-3.70)	(-3.46)	(-3.22)
Observations	18661	18661	17436	17436	17436

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The first two columns include only those variables for which coefficients are reported as control variables. The third column adds log(sales), a CEO dummy, age, age squared, board size, percentage of independent directors, percentage investment firm owned, Chairman/CEO dummy, FTSE100 dummy, FTSE250 dummy, log of positive profits, five year standard deviation of TSR, leverage, and time dummies as controls. The fourth column adds a linear time trend/treatment status interaction. The final model added interactions between both treatment groups/time periods and TSR to examine the impact of the 2011 reduction.

towards improving long term corporate performance. We test the robustness of this finding and consider alternative interpretations of our results in the appendix.

Table 6: Differential Pay-Performance Sensitivities

	Before A-Day	After A-Day	Difference	DiD
Treated	$\beta_3 + \beta_5$	$\beta_3 + \beta_5 + \beta_6 + \beta_7$	$\beta_6 + \beta_7$	β_7
	0.24***	0.08**	-0.16***	-0.21***
	(4.97)	(2.35)	(-2.81)	(-3.36)
Untreated	β_3	$\beta_3 + \beta_6$	β_6	
	0.03	0.07***	0.05**	
	(1.37)	(6.16)	(2.12)	

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
β parameters correspond to those in the model;
$log(pay)_{ijt} = \beta_1(Treat)_i + \beta_2(Post)_t + \beta_3(TSR)_{jt} + \beta_4(Post \times Treat)_{it}$
$+\beta_5(Treat \times TSR)_{ijt} + \beta_6(TSR \times Post)_{jt} + \beta_7(Treat \times Post \times TSR)_{ijt} + \alpha' X_{ijt} + \eta_{ij} + \epsilon_{ijt}$
Model estimated by fixed effects. Control variable vector X contains; log(sales), CEO dummy, age, age squared, board size, percentage of independent directors, percentage investment firm owned, Chairman/CEO dummy, FTSE100 dummy, FTSE250 dummy, log of positive profits, five year standard deviation of TSR, leverage, a linear time trend/treatment status interaction, and time dummies.

7 Conclusion

This paper incorporates executive pension benefits into an analysis of executive remuneration and its relationship with firm performance by exploiting the introduction of the A-day pensions simplification legislation in the UK. Executive pension benefits in the UK are widely used and comprise a significant proportion of the compensation package. The A-day legislation exogenously affected the cost of executive pensions and we see a strong change of provision in our sample. Many executives affected by A-day simply ended their defined benefit arrangements towards other forms of payment.

The intention of the legislation in respect of executive pension arrangements was to simplify and impose a cap on tax relief. However, a reading of the official documentation relating to the introduction of A-day does not mention any anticipated affects in relation to executive incentives. However, we find that, among those who were treated by the legislation a strong negative impact upon the pay-performance relation. We interpret this result as indirect evidence for the body of literature that views pension benefits as a component of an optimal contract, designed to align executive incentives with the providers of the firms capital. Interestingly, it is not alignment with the firms bondholders but alignment with the firms shareholders that appear to have been adversely affected by the reform (albeit in the classical interpretation, returns on both bonds and shares are a function of the firm's value (Merton,

1974) and so the bondholders interests are not so different from those of shareholders). This suggests that prior to the reform, defined benefit pensions were playing a role in incentive alignment.

What could this role be? There are a number of mechanisms that could be at work. First, the value of the defined benefit pension is a function of executives' final salary, which is a function of the firm's performance over the tenure of the executive. Hence, a generous defined benefit scheme could provide financial incentives to exert effort all the way until retirement age. This may indeed be the case but the estimates of pay-performance sensitivity used in this study are all at an annual level, suggesting a more immediate adjustment of pay and performance. Second, defined benefit schemes provide a degree of lock-in and may help retain the most talented executives and/or provide incentives for the executive to accumulated firm-specific capital. Third, generous pension benefits may have been used prior to A-day to offset a contract with a large proportion of at-risk pay, such as options and long-term incentives. Indeed, the treated groups in our sample do use long-term incentives more intensively and this diminished relative to the control group after A-day. This suggests total compensation design may be part of the story of how firms motivate executives while staying within acceptable bounds in terms of exposure to risk. However, confirmation of this hypothesis would require additional data on long-term scheme design and as such is left for future research.

Appendix

Robustness Checks

The difference in difference test shows that executives treated by A-day experienced a fall in their pay-performance sensitivity while those not treated by A-day saw an increase in their pay-performance relation over the same period. Our interpretation of these results is that A-day caused a fall in the pay-performance relation amongst the treated executives. In this section we consider and test for alternative interpretations of our finding.

Comparability of treatment and control groups

The first alternative narrative is that our division of treated and untreated executives splits the sample into two groups that are different from each other in ways that are unrelated to A-day and not captured by our controls or fixed effects. Then the different evolution could then reflect these other differences rather than the treatment of A-day itself.

Table 7 reports results from propensity score matching as a check of the robustness of the difference-in-difference experiment. Propensity score matching pairs a treated executive with

Table 7: Robustness Check 1: Difference-in-Difference with propensity score matching

	Intensive					Extensive		
	Pension	DB Total	DB	DC	Cash	DB	DC	Cash
	Panel A: Full Sample							
Post 06 × Treated 2006	-1.57***	-0.33*	-1.75***	0.26	0.15	-0.06***	0.04*	0.01
	(-5.69)	(-1.81)	(-5.73)	(0.93)	(0.55)	(-2.93)	(1.80)	(0.52)
N	19330	19330	19330	19330	19330	19330	19330	19330
Director-Firms	4785	4785	4785	4785	4785	4785	4785	4785
	Panel B: Restricted Sample (k=1 NN matching 0.01 Caliper)							
Post 06 × Treated 2006	-1.62***	-0.34*	-1.63***	0.13	0.10	-0.05**	0.03	0.01
	(-5.53)	(-1.78)	(-4.97)	(0.47)	(0.36)	(-2.18)	(1.37)	(0.36)
N	14301	14301	14301	14301	14301	14301	14301	14301
Director-Firms	3225	3225	3225	3225	3225	3225	3225	3225

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
All models are estimated controlling for executive-firm fixed effects.
Panel A reports the difference in difference results from the full sample. Panel B restricts the sample to include only observations with a propensity score that can be matched to an appropriate neighbour within a caliper of 0.01.

an untreated executive based on observable characteristics prior to the treatment taking effect. Observations are excluded if they cannot be matched. We use a nearest neighbour matching algorithm and impose a caliper of 0.01, using the pre-reform average values of the control variables in a probit model estimating the propensity score for each executive. The results are identical in terms of size and significance at the 5% level and the magnitudes of the treatment effects increase in all cases for the intensive margin outcome variables.

We extend this propensity score matching approach to our analysis of the pay performance sensitivity. Table 8 reports the differential pay-performance sensitivities by time and treatment status as Table 5, with additional columns for each of the two dependent variables containing the results using the matched samples.

The results in columns (5) and (10) indicate that refining the treatment and control groups does not substantially affect our previous findings. This reinforces our conclusions regarding the effect of A-Day on the pay performance sensitivity.

Table 9 futher checks the comparability of the treatment and control group. In particular, we ensure our results are not driven by a small number of executives at the top end of the distribution by removing potential outliers.[14] Table 9 compares our full sample results (reported in Panel A) with those obtained by imposing these restrictions. Panel B uses a 25% threshold, excluding any executive in the bottom 25% of the 2006 control group or the top 25% of the 2006 treated group. There are minor changes to the magnitudes of the estimated treatment effects but the results remain qualitatively the same.

[14]We take the difference between the executives' actual pensions prior to A-Day and the annual allowance and exclude those with differences of the highest magnitudes according to a threshold percentage.

Table 8: Robust Check 2: Table 5 with added propensity score matching in columns (5) and (10)

	Pay Including Pension					Pay Excluding Pension				
	(1) Raw	(2) +Controls	(3) +Trend	(4) +2011	(5) Matched	(6) Raw	(7) +Controls	(8) +Trend	(9) +2011	(10) Matched
Treated Pre [1]	0.24***	0.26***	0.24***	0.21***	0.23***	0.12***	0.13***	0.12***	0.10**	0.13***
	(4.95)	(5.23)	(4.97)	(4.58)	(4.64)	(2.88)	(3.02)	(2.72)	(2.39)	(3.26)
Treated Post [2]	0.10***	0.08**	0.08**	0.07**	0.07*	0.11***	0.09***	0.09***	0.08***	0.09***
	(3.16)	(2.43)	(2.35)	(2.01)	(1.92)	(4.15)	(3.44)	(3.09)	(2.92)	(2.83)
Difference [2] - [1]	-0.14**	-0.18***	-0.16***	-0.15***	-0.17***	-0.01	-0.04	-0.03	-0.02	-0.05
	(-2.39)	(-3.09)	(-2.81)	(-2.63)	(-2.81)	(-0.13)	(-0.82)	(-0.56)	(-0.45)	(-0.96)
Control Pre [3]	0.04**	0.03	0.03	0.04*	0.02	0.03	0.02	0.02	0.03	0.02
	(2.34)	(1.35)	(1.37)	(1.79)	(1.40)	(1.44)	(0.97)	(1.04)	(1.56)	(1.01)
Control Post [4]	0.09***	0.07***	0.07***	0.09***	0.07***	0.10***	0.08***	0.08***	0.10***	0.07***
	(8.24)	(5.87)	(6.16)	(5.34)	(4.99)	(8.16)	(6.38)	(6.12)	(5.08)	(5.12)
Control Difference [4] - [3]	0.05***	0.05**	0.05**	0.05**	0.04*	0.07***	0.06***	0.06***	0.06***	0.05**
	(2.78)	(2.05)	(2.12)	(2.13)	(1.92)	(3.02)	(2.64)	(2.71)	(2.76)	(2.06)
DiD ([2]-[1]) - ([4]-[3])	-0.19***	-0.23***	-0.21***	-0.20***	-0.21***	-0.07	-0.10*	-0.09	-0.09	-0.10*
	(-3.12)	(-3.60)	(-3.36)	(-3.31)	(-3.34)	(-1.45)	(-1.85)	(-1.61)	(-1.54)	(-1.79)
Observations	18661	17436	17436	17436	13576	18655	17441	17441	17441	13576

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Dependent variable; log total compensation including pension benefits in columns (1) - (5), log total compensation excluding pension benefits in columns (6) - (10)

Columns (1) and (6) report results using only TSR and the interaction terms as covariates, (2) and (7) add in control variables from the pay-performance regressions, (3) and (8) add a differential time trend for the treated group, and models (4) and (9) extend the model to include the 2011 reduction. Columns (5) and (10) respectively repeat columns (3) and (8) but restrict the sample to include only observations with a propensity score that can be matched to an appropriate neighbour within a caliper of 0.01.

Treated refers to executives treated by A-Day and pre/post refers to before/after A-Day - the 2011 reduction and the second treatment group are only considered in columns (4) and (8) and the results are omitted from this table due to insignificance.

Another technique to inspect how much of the difference in difference result is being driven by changes in pension arrangements is to rerun the difference in difference experiment without pension benefits included in the measure of total pay. This is shown in table 10. Columns (5) through to (8) estimate equation 3 without including pensions benefits in the dependent variable. Excluding pension benefits significantly reduces the estimated coefficient for β_7. Therefore it does appear to be pension benefits that are driving the pay-performance relation differences between the groups. In particular, the fall in the treated group's pay-performance relation ($\beta_6 + \beta_7$) disappears when pension benefits are excluded. Further reinsurance is obtained by inspecting the control group. The exclusion of pension benefits in the control group do not change the estimates, either before or after A-day. In summary, the difference-in-difference result is due to a fall in the pay-performance sensitivity of the treated group and this is entirely attributable to pension benefits, while the increase in the control group's pay-performance sensitivity is unrelated to the inclusion of pension benefits.

Table 9: Robustness Check (3): Difference-in-Difference excluding "extreme" observations

	Intensive					Extensive		
	Pension	DB Total	DB	DC	Cash	DB	DC	Cash
	A: Full Sample							
Post 06 × Treated 2006	-2.08***	-0.59***	-2.29***	0.12	0.58**	-0.08***	0.04	0.05**
	(-7.32)	(-3.09)	(-7.35)	(0.43)	(2.50)	(-4.09)	(1.46)	(2.49)
Post 11 × Treated 2006	-1.53***	-0.75***	-1.64***	-0.50*	1.47***	-0.07***	-0.03	0.13***
	(-4.07)	(-2.87)	(-3.99)	(-1.91)	(3.78)	(-2.71)	(-1.31)	(3.83)
Post 11 × Treated 2011	-0.36**	0.03	-0.48***	-1.17***	2.26***	-0.03**	-0.09***	0.21***
	(-2.13)	(0.28)	(-2.99)	(-5.67)	(9.76)	(-2.36)	(-4.61)	(9.96)
N	19330	19330	19330	19330	19330	19330	19330	19330
Director-Firms	4785	4785	4785	4785	4785	4785	4785	4785
	B: Top 25% Treated and Bottom 25% Control (A-Day) Removed							
Post 06 × Treated 2006	-1.80***	-0.67***	-2.02***	0.05	0.55**	-0.08***	0.03	0.05**
	(-5.90)	(-3.50)	(-6.12)	(0.16)	(2.12)	(-3.79)	(1.11)	(2.14)
Post 11 × Treated 2006	-1.40***	-0.87***	-1.59***	-0.48*	1.65***	-0.07**	-0.03	0.15***
	(-3.34)	(-3.57)	(-3.44)	(-1.65)	(3.75)	(-2.28)	(-1.09)	(3.80)
Post 11 × Treated 2011	-0.38**	0.03	-0.52***	-1.18***	2.29***	-0.03**	-0.09***	0.21***
	(-2.21)	(0.27)	(-3.28)	(-5.65)	(9.91)	(-2.53)	(-4.59)	(10.10)
N	18565	18565	18565	18565	18565	18565	18565	18565
Director-Firms	4585	4585	4585	4585	4585	4585	4585	4585
	C: Top 50% Treated and Bottom 50% Control (A-Day) Removed							
Post 06 × Treated 2006	-1.82***	-0.72***	-1.91***	-0.26	0.21	-0.10***	0.01	0.02
	(-5.66)	(-3.25)	(-5.18)	(-0.70)	(0.68)	(-3.94)	(0.27)	(0.75)
Post 11 × Treated 2006	-1.39***	-1.00***	-1.88***	-0.38	1.69***	-0.08**	-0.02	0.15***
	(-3.02)	(-3.49)	(-3.56)	(-1.14)	(3.11)	(-2.31)	(-0.60)	(3.11)
Post 11 × Treated 2011	-0.31*	-0.03	-0.46***	-0.89***	2.20***	-0.03*	-0.06***	0.21***
	(-1.72)	(-0.28)	(-2.71)	(-4.14)	(8.80)	(-1.88)	(-3.09)	(8.98)
N	11264	11264	11264	11264	11264	11264	11264	11264
Director-Firms	2490	2490	2490	2490	2490	2490	2490	2490

Asymmetric Performance

A second alternative interpretation of our findings based on the premise that the pay-performance relation in the UK has sometimes been estimated as greater in high performing firms and weaker in poor performing firms (Gregory-Smith and Main, 2014; Bell and Van Reenen, 2013). If the group treated by A-day happen to be higher performing firms prior to A-day than the control group, then mean reversion in the performance of these firms might account for decline in pay-performance sensitivity in the treated group, relative to the non-treated group. Figure 4 tracks the performance of the firms of the treated and control executives over our sample period.

Two things are noteworthy in figure 4. The first is the outlier of 2008 where the market

Table 10: Robustness Check 4: Including vs excluding pension benefits from measure of pay

	Pay Including Pension				Pay Excluding Pension			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Raw	+Controls	+Trend	+2011	Raw	+Controls	+Trend	+2011
Treated Pre [1]	0.23***	0.24***	0.22***	0.20***	0.11***	0.12***	0.10***	0.09**
	(4.80)	(4.75)	(4.23)	(4.19)	(2.79)	(2.99)	(2.60)	(2.44)
Treated Post [2]	0.11***	0.09***	0.09***	0.08**	0.11***	0.09***	0.09***	0.08***
	(3.46)	(2.80)	(2.64)	(2.48)	(3.85)	(3.18)	(2.98)	(3.01)
Difference [2] - [1]	-0.12**	-0.15**	-0.13**	-0.11**	-0.00	-0.03	-0.01	-0.01
	(-2.12)	(-2.56)	(-2.15)	(-1.97)	(-0.03)	(-0.52)	(-0.28)	(-0.15)
Control Pre [3]	0.04**	0.03	0.03	0.05*	0.02	0.02	0.02	0.03
	(2.23)	(1.49)	(1.54)	(1.90)	(1.37)	(0.83)	(0.80)	(1.32)
Control Post [4]	0.09***	0.08***	0.08***	0.09***	0.10***	0.08***	0.08***	0.10***
	(8.28)	(6.15)	(6.18)	(5.23)	(9.12)	(6.59)	(6.65)	(5.37)
Control Difference [4] - [3]	0.05**	0.05*	0.05*	0.05**	0.08***	0.07***	0.07***	0.07***
	(2.53)	(1.94)	(1.90)	(1.97)	(3.77)	(2.90)	(2.85)	(2.96)
DiD ([2]-[1]) - ([4]-[3])	-0.17***	-0.19***	-0.18***	-0.16***	-0.08	-0.09*	-0.08	-0.08
	(-2.86)	(-3.17)	(-2.76)	(-2.61)	(-1.44)	(-1.71)	(-1.45)	(-1.44)
Observations	18660	17442	17442	17442	18652	17444	17444	17444

t statistics in parentheses

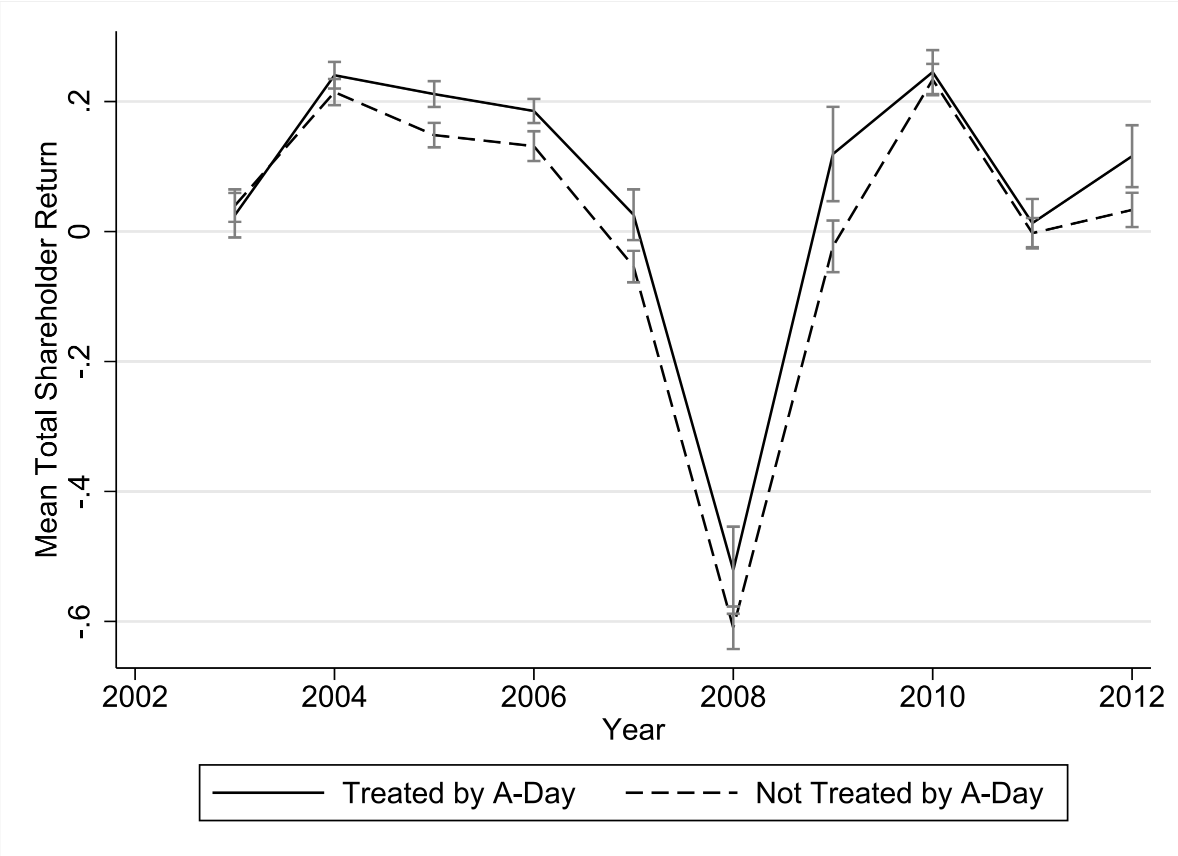
* $p < .1$, ** $p < .05$, *** $p < .01$

Dependent variable; log total compensation including pension benefits in columns (1) - (4), log total compensation excluding pension benefits in columns (5) - (8)

Columns (1) and (6) report results using only TSR and the interaction terms as covariates, (2) and (7) add in control variables from the pay-performance regressions, (3) and (8) add a differential time trend for the treated group, and models (4) and (9) extend the model to include the 2011 reduction.

Treated refers to executives treated by A-Day and pre/post refers to before/after A-Day - the 2011 reduction and the second treatment group are only considered in columns (4) and (8) and the results are omitted from this table due to insignificance.

Fig. 4: Firm performance by treated group



1. The figure shows the mean total shareholder return to firms with treated and untreated executives in our sample. While the firms in the treated group outperforms the firms in the control group, the trend in performance of the two groups is similar.

crashed after the financial crisis. The second is that the performance of firms with treated executives did slightly outperform the control firms prior A-day, but there is no evidence of mean reversion as they continue to outperform the control firms after A-day. Indeed, the trend of the two series is very similar. Table 11 looks at the performance of the two groups in more detail. The estimated coefficients show that the treated group's performance is greater than the control group but it is they are only significantly different in 2009 and marginally significant in 2012. This goes against the firm performance interpretation of the results as the estimated performance pay sensitivity is declines for the treated group post A-day.

Common Trends

An assumption of the difference-in-difference estimator is that the two groups exhibit common trends prior to the treatment. Perhaps, the treatment we attribute to A-day, is simply reflection of a continuation in the underlying trends of the two groups. Figure 5 inspects the trends over time in each of the measures of annual pension. The vertical line indicates A-Day. It is clear that the treated group experience a reduction to their overall annual pensions after A-Day and this is reflected in a decline in defined benefits and upturn in the average cash payment, neither of which are observed for the control group. The pre-reform trends are similar between the two groups in the case of defined contribution and cash payments. In the case of defined benefits, the two treatment and control groups actually exhibit divergent trends prior to A-Day. So it is possible that the effect we attribute to A-day is an underestimate of the true treatment effect, given that there is a reversal of these trends in both groups post A-day.

Additional information

For completeness, we provide the full estimates relating to table 4 in table 12.

Table 11: Robustness Check 5: Firm performance allowing for cohort effects

	Total Shareholder Return			Δ Log(Sales)		
	OLS	RE	FE	OLS	RE	FE
≥1 Treated Exec	-0.051	-0.052	-0.081	0.005	0.017	-0.019
	(-1.24)	(-1.24)	(-1.52)	(0.13)	(0.48)	(-0.49)
I(Year = 2004) × ≥ 1 Treated Exec	0.025	0.025	0.025	-	-	-
	(0.44)	(0.44)	(0.42)			
I(Year = 2005) × ≥ 1 Treated Exec	0.079	0.079	0.096	0.004	0.007	0.022
	(1.37)	(1.38)	(1.61)	(0.09)	(0.15)	(0.52)
I(Year = 2006) × ≥ 1 Treated Exec	0.088	0.089	0.110*	-0.034	-0.026	0.008
	(1.50)	(1.52)	(1.81)	(-0.72)	(-0.58)	(0.20)
I(Year = 2007) × ≥ 1 Treated Exec	0.083	0.084	0.113*	0.048	0.049	0.059
	(1.39)	(1.41)	(1.80)	(0.99)	(1.05)	(1.31)
I(Year = 2008) × ≥ 1 Treated Exec	0.046	0.047	0.065	-0.008	-0.004	0.010
	(0.75)	(0.76)	(1.00)	(-0.17)	(-0.08)	(0.23)
I(Year = 2009) × ≥ 1 Treated Exec	0.170***	0.169***	0.183***	0.020	0.028	0.037
	(2.71)	(2.71)	(2.75)	(0.39)	(0.57)	(0.76)
I(Year = 2010) × ≥ 1 Treated Exec	0.021	0.021	0.040	-0.016	-0.012	0.007
	(0.33)	(0.33)	(0.60)	(-0.32)	(-0.23)	(0.15)
I(Year = 2011) × ≥ 1 Treated Exec	0.034	0.035	0.054	0.014	0.016	0.021
	(0.53)	(0.54)	(0.79)	(0.26)	(0.31)	(0.42)
I(Year = 2012) × ≥ 1 Treated Exec	0.150**	0.150**	0.161**	0.028	0.028	0.016
	(2.24)	(2.25)	(2.26)	(0.51)	(0.54)	(0.32)
Observations	5350	5350	5350	4695	4695	4695

t statistics in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Firm level regressions, including firm random/fixed effects in columns 2 and 3 respectively of each dependent variable. Unreported control variables; log(sales), leverage, FTSE100 dummy, FTSE250 dummy, board size, percentage of independent executives.

First three columns use total shareholder return as the dependent variable, the second three use the change in log sales over the financial year as a proxy for firm growth as the dependent variable.

Fig. 5: Treated vs Control Group Trends in Log(Pension+1)

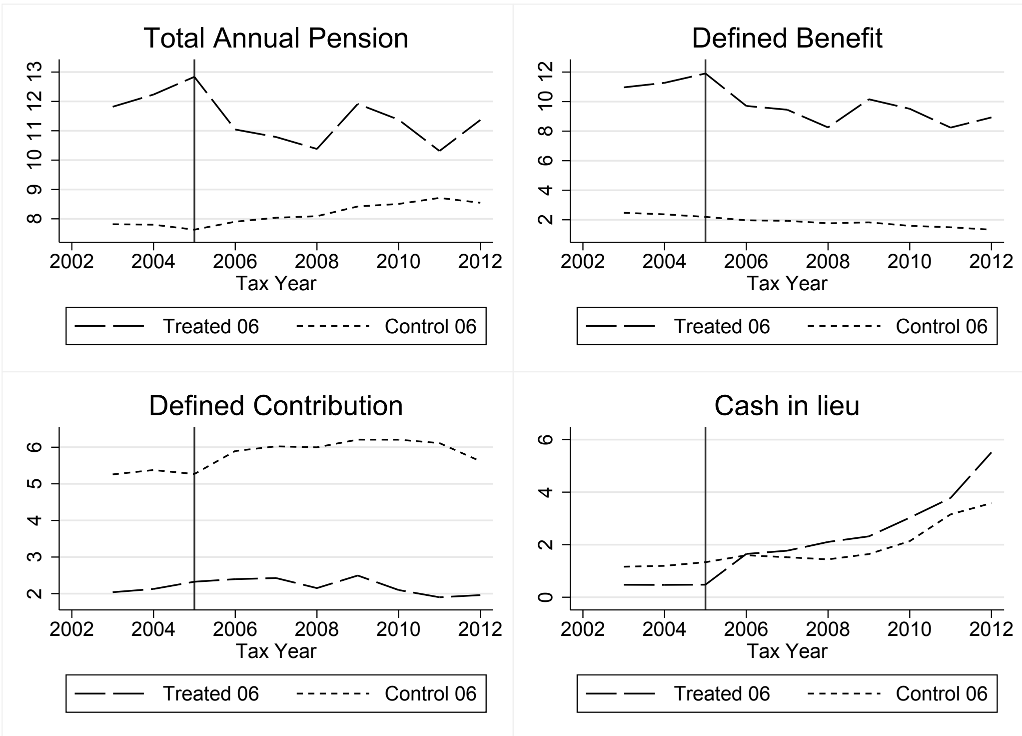


Table 12: Full estimates relating to table 4

	Intensive					Extensive		
	Pension	DB Total	DB	DC	Cash	DB	DC	Cash
Post 06 × Treated 2006	-1.23***	-0.67***	-1.54***	0.49**	0.68***	-0.05***	0.08***	0.06***
	(-5.29)	(-4.56)	(-6.16)	(2.15)	(3.25)	(-2.82)	(3.65)	(3.29)
Post 11 × Treated 2006	-1.20***	-0.60***	-1.51***	-0.35*	1.81***	-0.07***	-0.02	0.17***
	(-4.26)	(-3.09)	(-4.76)	(-1.66)	(5.97)	(-3.18)	(-0.95)	(6.11)
Post 11 × Treated 2011	-0.18	0.03	-0.19	-1.33***	2.32***	-0.01	-0.09***	0.22***
	(-0.94)	(0.33)	(-1.24)	(-5.41)	(8.97)	(-1.12)	(-4.24)	(9.12)
Trend	0.35	-0.04	0.43*	-0.75	0.78*	0.02**	-0.08	0.07*
	(0.85)	(-0.61)	(1.81)	(-1.31)	(1.84)	(1.99)	(-1.64)	(1.88)
Trend × Treated 2006	0.11*	0.07**	0.17***	-0.06	0.11**	-0.00	-0.01	0.01*
	(1.84)	(2.36)	(2.73)	(-1.02)	(2.18)	(-1.17)	(-1.52)	(1.86)
Trend × Treated 2011	-0.02	-0.02	0.02	0.01	0.01	0.00	-0.00	0.00
	(-0.41)	(-1.07)	(0.84)	(0.14)	(0.37)	(0.28)	(-0.49)	(0.16)
Log(Sales)	0.17*	0.03	0.13**	0.17*	-0.00	0.01***	0.01	0.00
	(1.87)	(0.83)	(2.12)	(1.82)	(-0.03)	(2.72)	(1.55)	(0.03)
Age	0.96**	0.14*	0.26	1.88***	-0.74*	0.02	0.18***	-0.06
	(2.20)	(1.82)	(1.00)	(3.19)	(-1.67)	(1.50)	(3.45)	(-1.62)
Age^2	-0.01***	-0.00**	-0.01***	-0.01***	0.00	-0.00***	-0.00***	0.00
	(-7.73)	(-2.13)	(-5.74)	(-6.87)	(0.31)	(-4.74)	(-6.20)	(0.09)
CEO	0.77***	-0.07	0.18	0.44***	0.41***	0.01	0.03**	0.03**
	(5.15)	(-0.98)	(1.53)	(2.63)	(2.80)	(1.03)	(1.99)	(2.26)
TSR	0.23***	0.02	0.18***	0.11**	0.09**	0.01**	0.01**	0.01**
	(4.24)	(0.73)	(4.13)	(2.14)	(2.42)	(2.27)	(2.36)	(2.54)
σ^{TSR}	0.14	-0.09	-0.28*	0.24	0.33**	-0.01	0.02	0.03*
	(0.87)	(-1.06)	(-1.92)	(1.26)	(2.06)	(-1.17)	(0.95)	(1.94)
FTSE100	1.02***	0.06	0.28	0.87***	0.03	0.01	0.08***	-0.00
	(3.87)	(0.46)	(1.16)	(3.01)	(0.11)	(0.39)	(2.99)	(-0.12)
FTSE250	0.48***	-0.07	0.17	0.43***	0.03	0.01	0.04***	0.00
	(3.73)	(-1.40)	(1.63)	(2.82)	(0.19)	(0.97)	(2.97)	(0.23)
% IC Owned	0.01**	-0.00	0.00*	0.00	-0.00	0.00**	0.00*	-0.00
	(2.40)	(-0.90)	(1.91)	(1.20)	(-1.30)	(2.15)	(1.77)	(-1.35)
% Independent NED's	0.92***	0.16	-0.11	1.27***	0.46	0.02	0.12***	0.04
	(2.75)	(1.24)	(-0.44)	(3.62)	(1.60)	(1.01)	(3.77)	(1.37)
Board Size	-0.13***	0.03***	-0.01	-0.12***	-0.03	-0.00	-0.01***	-0.00
	(-5.00)	(2.58)	(-0.68)	(-5.25)	(-1.36)	(-1.60)	(-5.46)	(-1.05)
Leverage	-0.16	0.23***	0.29**	-0.30	-0.21	0.02*	-0.02	-0.02
	(-0.79)	(2.85)	(1.97)	(-1.46)	(-1.21)	(1.91)	(-1.22)	(-1.26)
Constant	-11.11	0.18	5.35	-59.20**	33.01*	0.20	-5.84**	2.84*
	(-0.59)	(0.06)	(0.49)	(-2.28)	(1.72)	(0.39)	(-2.55)	(1.71)
N	19330	19330	19330	19330	19330	19330	19330	19330
Director-Firms	4785	4785	4785	4785	4785	4785	4785	4785

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