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Executive pensions and the pay-performance relation. Evidence from changes to pension legislation in the UK

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This paper evaluates the role of executive pensions in the relationship between executive compensation and corporate performance. As a natural experiment, we exploit a major change to the tax-free allowances governing executive pensions. This reform affected the cost of pensions for firms whose executives had accumulated pension benefits in excess of the prescribed limit. We find a strong reaction to the reform. After 6th April 2006, many executives saw their defined benefit pension schemes replaced with risk-free cash payments. This imposition of an exogenous constraint on the contracting over CEO pay significantly decreased the relationship between executive pay and firm performance.

JEL codes: J32 J33 M12 M52

Key Words: Executive compensation; Executive pensions; Performance-Pay Sensitivity

1 Introduction

Economists have thought carefully about how firms could set contracts with their senior executives to provide optimal pay incentives to deliver corporate performance. The formal theoretical contracting models of Holmstrom (1979) and Grossman and Hart (1983) detail the mechanics by which firms link performance and reward. The empirical counterpart, the sensitivity of the link between executive pay and corporate performance has become the benchmark in testing theories of corporate governance (Jensen and Murphy, 1990; Conyon et al., 2011; Gregory-Smith, 2012; Gregory-Smith and Main, 2015; Bell and Van Reenen, 2016).

However, a major omission in the empirical literature is the size and form of executive pensions. We argue that an understanding of the pension element of executive remuneration is crucial to a fully informed public debate regarding the pay-performance relation. Until recently, pensions benefits have not been disclosed with sufficient clarity to permit comparison between companies on a consistent basis over time. The pensions data in this study shows that pensions form a significant part of executive remuneration (as has been acknowledged in the US literature (Bebchuk and Jackson, 2005)). More significantly, we argue that pension benefits are likely to impact not only on total reward but also on the pay-performance relation

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in several ways that are not immediately obvious. For example, a company's defined benefit pension can serve as a retention device because the value of a defined benefit pension increases the longer the director stays in service with the company. Over time, this provides an incentive for high performing directors to remain and increases the cost to the company of retaining underperforming directors.

An analysis of the impact of recent changes in legislation relating to pensions offers a unique opportunity to test the impact of exogenous changes on remuneration where previously the endogenous nature of the pay-performance relation has confounded its estimation. For example, the structure of a CEO's pay contract and how performance is rewarded are the result of negotiations between the CEO and the firm's remuneration committee. In such circumstances, the fact that estimates of the pay-performance relation have sometimes been lower than expected (Jensen and Murphy, 1990) could 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 a radical reform in pension tax law in the UK on 6th April 2006 (known as 'A-day'). This natural experiment exogenously affected executive pension provision and also provided a control group of UK executives who were not affected by the legislation. This allows us to estimate the pay-performance relation for both the treated and untreated groups of executives, before and after A-day. We also examine a subsequent reform to the A-day rules in April 2011.

We find a strong reaction to A-day in terms of changes to executive pensions. After A-day, many executives saw their defined benefit scheme replaced with supplementary cash payments. While the value of defined benefit accruals is linked to company performance through the retention of higher performing directors, supplementary cash payments are risk-free and paid immediately. Our estimates suggest that this change had the unintended consequence of imposing a constraint on contracting over CEO pay and led to a significant decrease in the relationship between executive pay and firm performance for those executives affected by the reform. Quite simply, these directors had 'less skin in the game' (Jensen et al., 2004) post A-day.

The following section reviews the pay-performance literature and how executive pensions have been conceptualised. We then present the details of the A-day reform (section 3) and sample descriptives (section 4). Our econometric analysis is conducted in two stages. The first stage shows that the A-day reform imparts an exogenous shock to executive pension provision (section 5). The second stage shows this shock significantly decreased the pay-performance relation for those executives affected by the reform (section 6). Section 6 also checks for robustness and investigates the mechanisms linking pensions and performance. Section 7 concludes.

2 Literature

In the executive compensation literature, the pay-performance relation is examined by evaluating the estimated coefficient β from the following equation:

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

$$y_{it} = \gamma_i + \alpha_t + \beta(Performance)_{it} + \lambda(X)_{it} + \mu_{it} \quad (1)$$

where y_{it} is executive 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 (TSR) which captures dividends and share price growth and X is a vector of firm level controls, such as firm size.

The size of β measures the extent to which executive 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 executive. Given imperfect monitoring, a large and positive β provides economically meaningful incentives for the executive by rewarding performance and punishing failure[7]. The pay-performance literature has typically ignored the pension element of executive pay. That is not to say that executive pensions have never been considered. Below we discuss how executive pensions have been conceptualised in the literature to date and explain why they might play a key part in establishing the pay-performance relation. Our contribution to this literature is to examine the role that executive pensions play in delivering returns to shareholders.

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 USA 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 executives to inflate their total pay without attracting outrage from outsiders who might otherwise attempt to constrain their pay. In other words, pensions are stealth payments, consistent with the Bebchuk and Fried (2003) 'managerial power' thesis that portrays CEOs as having 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 defined benefit 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 per year subject to an employee's age). It follows that a CEO, who is sitting on a multi-million pound pension, stands to lose nearly all of it if they take risks that result in company bankruptcy (Edmans and Gabaix, 2009)[8]. Sundaram and Yermack (2007) show, in a sample of 237 CEOs, that those with large defined benefit pensions behave more conservatively (lower risk of firm default).

An objection to this view is that equity payments to CEOs, in the form of share options, may act in the opposite direction and provide CEOs with incentives to undertake risky projects. Arguably, it is counterintuitive for firms to simultaneously provide to their CEOs sizeable amounts of both equity and inside debt. This suggests that pensions may play some role other 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

[7] See Gregory-Smith and Main (2015) for recent estimates.

[8] Albeit that in practice a company might honour its pension obligations before those to other creditors (Bebchuk and Jackson, 2005).

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. Additionally, Wei and Yermack (2011) provide empirical evidence supporting the use of pensions as inside debt.

The novelty of our contribution is to propose that executive pensions can align the interests of the executive with those of shareholders, not just bondholders, and in so doing strengthen the pay-performance relation. While it is intuitive to model executive pensions as inside debt, we argue that certain types of executive pensions may additionally provide easy to overlook, but significant, performance incentives. For example, defined benefit (DB) pensions can act as a means to secure retention of key employees with each subsequent year on a DB being, on average, more valuable than the last, a form of 'deferred compensation' (Lazear, 1979). Therefore, the incentives for good performers to remain increase, while from the firms' perspective the retention of poor performers becomes more costly. This introduces a greater number of good performers on well paid DBs into the data, as a result of pension incentives designed by the firm.

Empirical work on this topic is rare. Goh and Li (2015) find that pensions substitute for performance based pay for FTSE100 executives between 2004 and 2011. 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 just because of managerial power but because decisions on monitoring, pensions and performance pay have been taken simultaneously. For example, if, as we argue, pensions increase the pay-performance relation, then a greater use of pensions would mitigate the need for the more obvious, if actuarially more expensive, performance linked reward components of bonuses and share options. In the absence of any exogenous variation in these variables it is hard to distinguish between the competing interpretations. To address this problem, and identify the causal effect of pensions on the pay-performance relation, our study will exploit the reform of UK pension legislation introduced in 2006, which represented an exogenous shock to the design of reward arrangements.

3 Reform of UK Pension Legislation

The 6th of 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 novel feature of the legislation was the introduction of annual and lifetime allowances initially set at £215,000 and £1.5 million respectively. These allowances represented caps on the amount of pension which could benefit from tax relief. If the value of the accumulated pension benefits exceeded the allowance then the excess pension was subject to a surcharge of 25%. Given that individuals who earn enough to breach the allowances were highly likely to be in the 45% tax bracket, this amounted to a 58.75% tax on pensions in excess of the

allowance. A 58.75% tax rate also applied to the part of any lump sum payment that is in excess of the allowance.

The UK tax year runs from 6th April to 5th April the following year. Directors' payments for the year are disclosed at each company's 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 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 consequently is subject to inertia.

From A-Day until the 2010 tax year the annual allowance increased by £40,000 to £255,000. 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.

Figure 1 provides an indication of the proportion of executives in the FTSE350 who have been affected by these reforms to the pension system[9]. There are two clear discontinuities, at 2006 and 2011. With the initial introduction of the £215,000 annual allowance and £1.5 million lifetime allowance just under 20% of executives were caught by one of the two allowances, with the annual allowance catching more executives than the lifetime allowance[10]. The subsequent modest changes to the pension caps between 2006 and 2011 did not substantially change the proportion of executives in excess of the allowances. However, the significant tightening of the annual allowance effective from April 2011 had a large effect, with an approximate 40% point increase in those affected to over half of all executive directors in the sample.

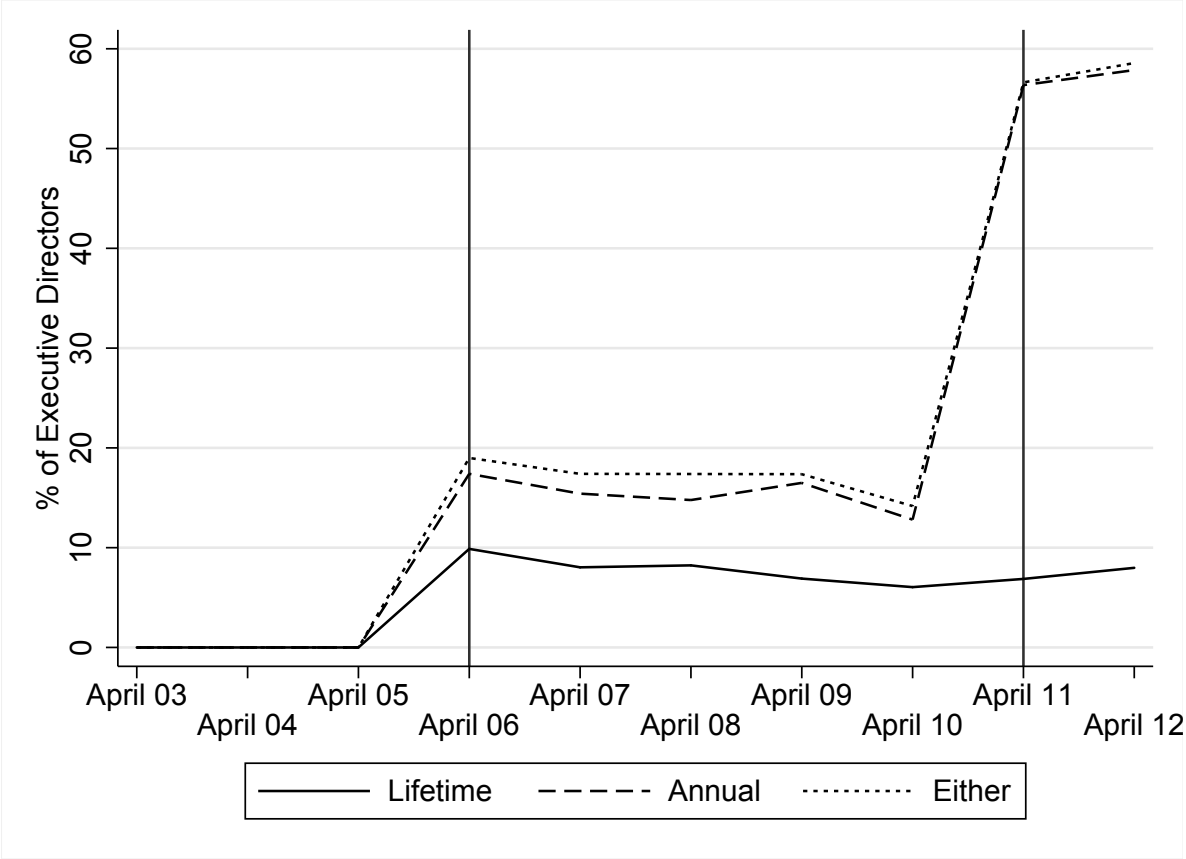
4 Data

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

[9]In the years post 2006, the figure becomes an underestimate of the total number of executives 'affected' because, as shown below, after A-day a significant number of executives switched out of their defined benefit pensions specifically to avoid the allowances introduced by A-day. Only directors with defined benefit schemes can be identified as exceeding the lifetime allowance because UK legislation only requires the accumulated transfer value of defined benefit schemes to be disclosed. In practice, very few directors will be able to exceed the lifetime limit through a defined contribution scheme without also exceeding the annual allowance (which is identified for all schemes).

[10]Unfortunately, only pension benefits held at the company of employment are required to be disclosed under UK listing rules. Therefore, a director may have outstanding pension benefits with previous employers unless these have been transferred across to the current company's scheme. Therefore, while the number of directors caught by the annual allowance is accurate, we may be underestimating the number of directors affected by the lifetime allowance. To the extent this occurs, our subsequent analysis underestimates the differences between the treated and control groups. However, in practice, Figure 1 shows there are very few directors who are caught by lifetime allowance who are not also caught by the annual allowance.

Fig. 1: Percentage of Executives in Excess of A-day Pension Allowances



Notes: The figure shows the proportion of executive directors in our sample that were in breach of the pension allowances introduced on the 6th April 2006 and the subsequent changes to those allowances.

(inclusive). Minerva Analytics 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. Only 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.

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 (LTIPs), share options, pensions, and other perquisites. Options and LTIPs are valued at grant date. We control for executive equity ownership albeit we are unable to observe historical unexercised, but not yet lapsed, share options[11]. 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 benefit 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.

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. This enables an annual valuation for this type of pension benefit to be calculated by taking the change in the transfer value. It is important to note that this is an imperfect measure, firstly because market movements and actuarial assumptions influence the figure. Secondly, it does not necessarily equal the value that the executive would place on that additional year of service. Nevertheless, the figure is audited to actuarial standards and is the most objective measure of pension value available. Moreover, to the extent that there are fixed effects between companies or common changes in actuarial practice over time, these will be controlled for in our subsequent econometric analysis.

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 obtained from 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

[11] We would like to measure changes in total wealth, including changes to the value of the executive's option portfolio (Edmans and Gabaix, 2015). However, our data during the sample period does not identify historical option grants and unexercised (but not lapsed) options with sufficient detail to calculate changes to the executive's portfolio.

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

Table 1 shows the sample means of the key variables of interest before and after A-day for both the treated and control directors. The treated directors are those captured by either the annual or lifetime allowance prior to 2006 and all other directors are designated as controls. Notably, while compensation generally increases over the period the change in defined benefit transfer values decrease dramatically for the treated group. However, whether or not this is due to A-day can not be concluded at this stage because other variables are changing over time as well as exhibiting differences between the treated and control group. These differences will be controlled for in our subsequent analysis.

Table 1: Mean value of variables before and after A-day

	Pre A-day 2003-2006			Post A-day: 2006-2012		
	(1)	(2)	(3)	(4)	(5)	(6)
	Treated	Control	Diff t-test	Treated	Control	Diff t-test
Salary (£000s)	473.905	279.232	***	468.878	294.399	***
			(-30.53)			(-34.87)
Bonus (£000s)	212.058	120.978	***	323.008	196.994	***
			(-10.23)			(-13.63)
Long Term Incentives (£000s)	354.116	170.263	***	631.322	270.627	***
			(-4.97)			(-17.07)
Other Pay (£000s)	41.921	32.653	***	56.002	29.561	***
			(-3.11)			(-8.46)
Total Pension (£000s)	575.748	42.514	***	440.953	56.911	***
			(-22.74)			(-41.08)
Defined Benefit Transfer Value Change (£000s)	535.692	10.135	***	373.621	8.939	***
			(-22.46)			(-40.44)
Defined Contribution (£000s)	32.817	23.083	***	32.165	31.202	
			(-4.59)			(-0.47)
Cash in lieu of Pension (£000s)	7.239	9.296	*	35.207	16.784	***
			(1.72)			(-13.12)
Age	51.435	47.867	***	52.317	49.127	***
			(-21.28)			(-22.72)
Tenure	4.947	3.732	***	5.526	3.934	***
			(-10.25)			(-15.02)
CEO	0.272	0.269		0.319	0.300	*
			(-0.30)			(-1.93)
Sales (£m)	6.466	1.006	***	11.472	1.848	***
			(-21.58)			(-26.70)
Total Assets (£m)	22.431	3.488	***	45.050	11.447	***
			(-15.96)			(-12.97)
FTSE100	0.365	0.076	***	0.401	0.121	***
			(-34.66)			(-34.66)
Board Size	10.824	8.857	***	10.723	8.887	***
			(-25.73)			(-28.04)
Total Shareholder Return (TSR)	0.165	0.129	***	0.002	-0.068	***
			(-3.44)			(-5.27)
Number of observations	2415	5771	8186	2710	9269	11979

Notes:
1. This table gives the mean values of the key variables used in the analysis, broken down by group, before and after A-day. 'Treated' directors are those that were in breach of either the annual or lifetime allowance in 2006. All other directors are in the 'control' group.
2. The columns 'Diff t-test' reports the significance level and t-statistic for the difference in mean values between the treated and control group.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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

There are strong indications that pension reform has influenced these trends. Despite the pre-existing decline in the popularity of defined benefit payments[12] there is a noticeable drop

[12]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 payments partly reflects executives switching firms and being unable to access defined benefit schemes in their new firm.

in payments following A-Day by almost 10% points between the 2005 and 2006 tax years. Initially, defined contribution payments increased in relative terms 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.

Table 2: Pension payments 2003-2012

		% of Total Payments			Mean Value (£)		
Tax Year	Firms	DB	DC	Cash	DB	DC	Cash
2003	605	41	48	10	162,140	29,888	9,213
2004	581	39	50	11	215,610	32,553	11,583
2005	548	38	50	12	254,869	35,478	11,769
2006	541	31	53	15	137,656	36,903	18,168
2007	517	30	55	15	117,316	38,969	19,803
2008	498	28	57	15	111,456	43,170	22,021
2009	480	27	57	16	131,098	43,690	23,668
2010	472	24	55	21	90,889	39,418	27,973
2011	440	20	52	28	103,944	34,629	36,684
2012	299	20	48	32	83,585	27,730	44,716

1. This table shows the percentage of total payments, and the mean values, accounted for by the three types of executive pension arrangement by year.
2. Mean values are in nominal pounds sterling.
3. The data is structured to the tax year ending in April with the sample ending in December 2012 (hence the smaller number of firms in in 2012).

Table 2 also shows the generosity of defined benefit payments compared to defined contribution payments or cash in lieu payments. Prior to A-Day, the mean annual defined benefit pension was many times more the mean value of either of the other two types of pension provision. This reflects the increased valuation of DB schemes arising from lengthening tenure on the job. The impact of A-Day on defined benefit values appears to have been substantial, halting the year-on-year increase in their mean value, and falling by over £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 payments 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.

We present the main determinants of pensions in Table A1 of the appendix, both in terms of the type of pension provided and value of that pension. To summarise: CEOs relative to executive directors have larger pensions overall but are not systematically more likely to have defined benefit pensions. Older directors are more likely to be on a defined benefit scheme along with directors in larger companies and companies with higher leverage. The proxies for corporate governance (institutional ownership, board size and the proportion of independent non-executive directors) do not explain much of the variation in pension type or pension value

in our data. We control for these director level and firm level determinants in our analysis below.

5 The Impact of A-day on Executive Pensions

Since we propose that the A-day change in regulations constrained executive pensions and that this decreased the pay-performance relation, our econometric analysis is conducted in two stages. In this section we estimate the first stage, that is we demonstrate that the April 2006 UK pension legislation reforms significantly changed executive pension provision. Using a difference-in-differences framework we show the legislation changed both the amount of pension received and the type of pension arrangement. The value of executive pensions fell significantly after 2006, with defined benefit / final salary schemes being replaced with either defined contributions or risk-free cash supplements. Later, the second stage of our analysis will demonstrate these changes impacted negatively on pay-performance sensitivity.

We examine the impact of both A-Day in April 2006 and the subsequent 2011 reduction in the annual allowance to £50,000. We separately identify the three treatment groups that are defined in Table 3 below.

Table 3: Definition of Treatment and Control Groups

Variable Name	Treatment Definition	Control Definition
Treatment/control groups for A-Day:		
$Treat^{06}$	Executives who exceeded the lifetime allowance or the annual allowance at any point prior to A-Day	Executives who did not exceed either allowance prior to A-day
Treatment/control groups for 2011:		
$Treat^{06}$	Executives active in 2011 who exceeded the lifetime allowance or the annual allowance at any point prior to A-Day 2006*	Executives who never exceeded either allowance
$Treat^{11}$	Executives not affected prior to A-Day but who exceed the £50,000 annual allowance or lifetime allowance prior to 2011	Executives who never exceeded either allowance

We estimate a panel data model with individual director-firm fixed effects:

$$y_{ijt} = \tau_1(Treat^{06} \times Post^{06})_{it} + \tau_2(Treat^{06} \times Post^{11})_{it} + \tau_3(Treat^{11} \times Post^{11})_{it} + \alpha' \bar{X}_{ijt} + \eta_{ij} + \delta_t + \epsilon_{ijt} \quad (2)$$

In equation 2, 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. In each case, y_{ijt} denotes the dependent variable which is either a continuous variable of the value of the pension or a binary variable indicating membership of that type of pension arrangement. There are three types of pension benefits: defined benefits, defined contributions, and cash-in-lieu of pension arrangements.

All specifications include the control vector $\bar{X}$. This comprises log of sales to proxy firm size, the executive's age and tenure, an indicator of 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 include a performance volatility variable. This is created as the standard deviation of firm performance over the most recent five financial years. To control for corporate governance we include the percentage of shares owned by investment companies, the percentage of independent non-executive directors (NEDs) on the board, and the total number of directors on the board. η_{ij} denotes the executive-firm fixed effects and δ_t year fixed effects. Treatment effects for extensive pension provision[13] are estimated in a linear probability model with fixed effects.

The results of this analysis are presented in Table 4. 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. The first four columns report the intensive margin which captures the change in the value of each type of pension arrangement. The final three columns report the extensive margin which represents a dummy variable for scheme participation. With the dependent variable in log form, the estimated coefficient on the value of defined benefits of -1.12 is equal at the mean to a reduction of approximately £270,000 per year (see second column, Intensive margin). As well as being statistically significant, this estimate is economically significant, being approximately equal to 50% of the treated group's average salary and it is consistent with what is observed in the descriptive statistics in Table 1. Defined contributions were not significantly reduced immediately 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 executives switching out of defined benefit arrangements into cash supplements (extensive margin). Consistent with the descriptive statistics shown earlier, we estimate an 8% point reduction in the use of defined benefit schemes and a 12% point increase in the use of cash payments. However, the increase in cash payments (approximately £25,000 per year at the mean), is substantially less than the reduction in the value of 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 perhaps curious that the compensation appears to fall 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-differences estimate understates the total amount of cash compensation. We observe a positive and significant increase in the use of cash for both groups over time (approximately £10,000 per year), which accounts for some, but not all, of the discrepancy. Additionally, total compensation for

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

these executives did not fall over the sample period. In fact, during this sample period other elements of executive pay, such as bonuses and the value of equity incentives increased.

The second and third rows of Table 4 demonstrate that 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 ($Treat^{06}$) were once again caught by the reduction in tax allowance. On the intensive margin, the reduction to defined benefit schemes is approximately equal to £180,000 per year at the mean (column 2, row 2). Additionally, some executives not affected in 2006, also saw a reduction in their pension benefits in 2011 ($Treat^{11}$). 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 £32,000 per year at the mean (column 4, row 3). On the extensive margin, we see an additional exit in 2011 from both defined benefit and defined contribution schemes (12 percentage points) and an uptake of cash supplements (18 percentage points). Taken together, these results reveal that the pension reforms imposed major changes to the structure of executive pension arrangements.[14]

6 Pension Reform and Pay-Performance

We now turn to the second stage of the analysis, where we examine how the exogenous shock to pensions caused by the legislation reform impacted on the pay-performance sensitivity of those executives affected. We again adopt a difference-in-differences framework to examine how A-day affected pay-performance sensitivity for our treated and control groups, by modifying equation (1) by interacting a treatment dummy, post-reform dummy, and TSR performance as follows:

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

The estimates of the β coefficients in equation 3 are presented in Table 5.[15] The estimate of the causal effect of the reform on total pay-performance sensitivity is shown in the final row. These results show that the executives treated on A-day saw their pay-performance sensitivity decrease after A-day, compared to those executives not affected by the reform. The DiD estimates range from a decline of 30% points (column 1) with no controls to 20% points when a full set of firm level and individual level controls is included (column 2).

Column (2), our preferred specification, reveals what lies behind the large decline in pay-performance sensitivity for the treated executives. The pay-performance sensitivity of the treated group (0.227) is substantially larger than that of the control group (0.035) prior to A-Day. Post-reform, the treated group and untreated group have a pay-performance elasticities of 0.11 and 0.12 respectively (rows labelled [2] and [4]).

[14] The conclusions of this section are robust to the use of a matched sample, as shown in section A1.2.

[15] For brevity, only the β coefficients are reported. The estimated coefficients on the control variables are very similar to those reported in Table A3, and are available on request.

Table 4: Pension Reform Treatment Effects

		Intensive Margin			Extensive Margin		
	All	DB	DC	Cash	DB	DC	Cash
$Treat^{06}$. Post06	-0.90***	-1.12***	0.00	1.39***	-0.08***	0.02	0.12***
	(-4.84)	(-6.03)	(-0.02)	(6.27)	(-5.96)	(1.07)	(6.08)
$Treat^{06}$. Post11	-0.98***	-1.06***	-0.51**	1.83***	-0.09***	-0.04*	0.16***
	(-3.53)	(-3.73)	(-2.02)	(5.92)	(-4.22)	(-1.79)	(5.76)
$Treat^{11}$. Post11	-0.60***	-0.17	-1.42***	1.91***	-0.02	-0.12***	0.18***
	(-2.92)	(-1.24)	(-5.77)	(7.32)	(-1.42)	(-5.07)	(7.27)
Log(Sales)	-0.01	0.06	0.06	-0.04	0.01	0.00	-0.00
	(-0.14)	(0.94)	(0.66)	(-0.61)	(1.61)	(0.46)	(-0.50)
Age	1.42***	0.58**	1.99***	-0.72*	0.03**	0.19***	-0.06*
	(3.57)	(2.24)	(3.41)	(-1.80)	(2.27)	(3.70)	(-1.73)
Age^2	-0.01***	-0.01***	-0.01***	0.00	-0.00***	-0.00***	0.00
	(-5.15)	(-4.21)	(-5.55)	(0.66)	(-3.48)	(-5.07)	(0.39)
CEO	0.06	-0.13	0.07	0.23	-0.02	-0.00	0.01
	(0.27)	(-0.94)	(0.37)	(1.62)	(-1.49)	(-0.04)	(1.15)
TSR	0.14**	0.07	0.16***	0.02	0.01*	0.02***	0.00
	(2.47)	(1.47)	(2.72)	(0.48)	(1.75)	(2.65)	(0.48)
σ^{TSR}	0.07	-0.26*	0.34*	0.34**	-0.02	0.03	0.03**
	(0.43)	(-1.67)	(1.68)	(2.03)	(-1.35)	(1.47)	(1.96)
FTSE100	0.59**	0.14	0.69**	-0.12	-0.01	0.06**	-0.02
	(2.27)	(0.58)	(2.32)	(-0.46)	(-0.40)	(2.38)	(-0.65)
FTSE250	0.31**	0.11	0.34**	-0.01	0.00	0.04**	-0.00
	(2.50)	(1.05)	(2.29)	(-0.10)	(0.33)	(2.51)	(-0.01)
% IC Owned	0.01***	0.01**	0.01**	-0.00	0.00*	0.00***	-0.00
	(2.74)	(2.12)	(2.30)	(-1.60)	(1.65)	(2.98)	(-1.56)
% Independent NED's	0.58*	-0.31	1.12***	0.36	0.01	0.11***	0.03
	(1.83)	(-1.25)	(3.24)	(1.29)	(0.46)	(3.38)	(1.07)
Board Size	-0.11***	-0.01	-0.12***	-0.02	-0.00	-0.01***	-0.00
	(-4.86)	(-0.53)	(-5.20)	(-1.09)	(-1.38)	(-5.38)	(-0.81)
Leverage	-0.12	0.27*	-0.25	-0.17	0.02**	-0.02	-0.02
	(-0.61)	(1.81)	(-1.23)	(-1.00)	(2.03)	(-0.97)	(-1.03)
Tenure	-0.01	-0.01	0.02	-0.01	-0.00	0.00	-0.00
	(-0.59)	(-0.80)	(0.90)	(-0.40)	(-0.01)	(0.87)	(-0.20)
Salary/100,000	0.081***	0.035***	0.046***	0.021***	0.003***	0.004***	0.002***
	(4.40)	(4.15)	(4.46)	(4.00)	(4.16)	(4.20)	(3.99)
N	19347	19347	19347	19347	19347	19347	19347
Director-Firms	4787	4787	4787	4787	4787	4787	4787
F-Stat	13.2	7.77	8.47	16.2	6.25	7.81	15.7
R-Sq	0.157	0.070	0.065	0.107	0.075	0.055	0.101

1. This table reports the estimated coefficients for equation (2). DB is defined benefit, DC is defined contribution
2. The dependent variable when estimating the intensive margin is specified as ln(1+y), where y is the annual payment under the respective pension type. The dependent variable when estimating the extensive margin is binary, indicating participation in the scheme.
3. Each specification controls for executive-firm fixed effects.
4. t-statistics in parentheses adjusted for clustering at executive-firm level; * p < 0.1, ** p < 0.05, *** p < 0.01

To examine the extent to which these changes in total pay sensitivity are driven by the change in pension arrangements, we re-estimate the model, first without pension benefits included in the measure of total pay (columns (3) and (4)) and then with pensions as the dependent variable (columns (5) and (6)). It can be seen that when benefits are excluded (column (4)) then the difference-in-difference estimate is substantially reduced due to a fall in the estimated pay sensitivity of the treated group pre-reform.[16] In contrast, when total pension is used as the dependent variable (column 6), the estimated fall in the pay sensitivity of the treated groups increases in magnitude, as does the difference-in-differences estimate (row DiD).

The table also indicates the extent to which the omission of pension benefits impacts the estimation of pay-performance sensitivity. In the post period, the difference in the estimated sensitivity is marginal and not statistically significant. However, the omission of pension benefits underestimates the pay-performance sensitivity of the treated group (essentially those directors with defined benefit pensions) by 6.9% points (row [1], column (4) minus column (2)) i.e. just under one-third in relative terms.

Robustness

We have undertaken a number of checks to examine the robustness of the results obtained by the difference-in-differences estimator. Firstly, we more tightly control for potential differences between the treatment and control group prior to A-day by the use of propensity score matching (Table A4, column (5)). The estimated coefficients are essentially unchanged. We also allow for a difference in the pre-reform trend of pay-performance sensitivity of the two groups; the common trends assumption (column (4)). Again, our results are not sensitive to this assumption.

Table A4 column (6) conducts the test only on CEOs in our sample and the result remains. This is perhaps unsurprising given that there is likely to be more variation in CEO pay-performance sensitivity than executive pay-performance sensitivity.

We also examine whether our results are sensitive to the fact our data sample spans the financial crisis in 2008, which caused a decline in TSR. Table A4 column (7) excludes the 2008 financial crisis year, and column (8) excludes both CEOs and the financial crisis year. In both cases the size and statistical significance of the effect remains robust. This rules out the possibility that our results are driven by CEOs experiencing lower pay-performance sensitivities during the crisis.

Finally, we also explicitly include directors treated by the 2011 reduction in annual pension allowance (Table A4, column (3)), again with little effect on our original finding that A-day imposed a constraint on contracting over executive pay and reduced the pay-performance sensitivity of those executives affected by the reform.

To summarise, we find robust evidence that the reforms to UK pension legislation implemented in 2006 exogenously reduced the pay-performance relation of those executives with relatively large pensions, bringing them in line with the lower pay-performance sensitivity of the control group of directors. Since A-Day had its largest impact on those with defined benefit pensions,

[16]The measured increase in the pay sensitivity of the control group in column (4) is almost identical to that in column (2) (0.085 compared to 0.084), reflecting the general trend in the market towards more bonuses and equity incentives over the period.

Table 5: Effect of Pension reform on Pay-performance sensitivity

	Total Pay (inc pension)		Total Pay (excl pension)		Total Pension	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated Pre [1]	0.237***	0.227***	0.137***	0.158***	0.344***	0.270***
$\beta_3 + \beta_5$	(5.92)	(5.64)	(3.99)	(4.45)	(3.84)	(3.11)
Treated Post [2]	0.082***	0.111***	0.102***	0.136***	0.008	-0.010
$\beta_3 + \beta_5 + \beta_6 + \beta_7$	(3.41)	(4.32)	(4.51)	(5.48)	(0.18)	(-0.22)
Difference [2] - [1]	-0.155***	-0.116**	-0.035	-0.023	-0.336***	-0.281***
$\beta_6 + \beta_7$	(-3.39)	(-2.45)	(-0.86)	(-0.52)	(-3.47)	(-3.00)
Control Pre [3]	-0.054***	0.035	-0.049**	0.042*	-0.115***	0.010
β_3	(-2.76)	(1.64)	(-2.46)	(1.94)	(-4.99)	(0.38)
Control Post [4]	0.096***	0.119***	0.100***	0.126***	-0.015	-0.023
$\beta_3 + \beta_6$	(7.96)	(8.18)	(7.97)	(8.33)	(-1.11)	(-1.27)
Control Difference [4] - [3]	0.150***	0.084***	0.149***	0.085***	0.100***	-0.033
β_6	(6.52)	(3.31)	(6.34)	(3.26)	(3.72)	(-1.04)
DiD ([2]-[1]) - ([4]-[3])	-0.305***	-0.199***	-0.184***	-0.107**	-0.435***	-0.248***
β_7	(-5.95)	(-3.95)	(-3.92)	(-2.29)	(-4.34)	(-2.61)
Control variables	No	Yes	No	Yes	No	Yes
Observations	18125	18125	18125	18125	15396	15396
Executive-Firms	4595	4595	4595	4595	3933	3933
F-Stat	36	25.1	39.1	22.1	14	22.9
R-Sq	0.019	0.078	0.019	0.073	0.011	0.083

1. This table presents the estimates of pay-performance sensitivity for the treated and control groups before and after A-day from equation (3).
2. Columns 1-2 use total pay as the dependent variable. Columns 3-4 exclude pensions from total pay and columns 5-6 use pensions only. The first of the columns in each pair reports the raw sensitivity, with the second including the set of observable control variables shown in Table 4.

the results presented indicate that such pensions may have constituted part of an optimal contract in which executive pension arrangements were related to performance.

Investigating mechanisms

Executive pensions, whether defined benefit schemes or contributory schemes, are not typically considered as a means of linking executive compensation and firm performance. In the mandated disclosures within a company's remuneration report, pensions are presented as part of 'fixed' pay rather than 'variable' compensation. At first glance therefore, our result that pensions play an important role in shaping executive incentives is unexpected. However, it is possible to consider a number of potential mechanisms that would result in a positive pension-performance sensitivity. These are: retention of more able directors in firms with DB schemes; the retention of DB pension schemes by high performing firms; the link between final salary and accumulated performance; and the co-existence of pension with performance incentives schemes. We consider each of these mechanisms in turn.

Director retention

A potential mechanism linking pensions to performance occurs through the retention on DB schemes of better performing executive directors. Table 6 shows the results from four different specifications estimating the determinants of executive survival within the firm. The hazard ratio shows that, as might be expected, the likelihood of exit falls[17] as sales increase and TSR rises. It also shows that those on defined benefit schemes are more likely to stay with the firm, suggesting that such schemes could be used as a retention mechanism for more able directors by the firm.

Evidence to support this contention is provided in Table 7, which shows that better performing individuals are, on average, longer tenured, and such individuals are more likely to be on defined benefit pensions and have a DB pension of high value. This emphasises the importance of defined benefit pensions in fostering retention.

Retention of DB schemes

A related alternative to the director retention hypothesis is that better performing firms, with the better directors, are more likely to retain their defined benefit schemes.[18] Table 8 considers all firms with an active DB scheme at the start of the sample in 2003, and relates whether the firm is still operating its DB scheme to firm level performance. Although DB retention is correlated with firm level performance in the raw data, the strength of the association diminishes with the addition of controls and loses statistical significance when firm fixed effects are controlled for (column 4). Thus, within firm variation in TSR does not significantly impact upon DB retention. While this is a demanding specification, it does suggest that the retention mechanism is not the dominant mechanism explaining the link between pensions and performance in the DiD estimations above (which also control for firm fixed effects).

Salary and Performance

A third possible mechanism that may generate a correlation between pensions and performance occurs because the value of a defined benefit pension is a function of the final salary of the executive. If this final salary is an accumulation of upward salary adjustments as a reward for good performance, then the DB pension could be a function of the firm's performance over the tenure of the executive. The manner in which a defined benefit scheme is an accumulation of rewards for good performance means that it could act as a mechanism to invest in firm-specific human capital and incentivise high effort throughout an executive's career until retirement age.[19]

It is interesting to note that annual salary and total compensation decline, on average, after six years and the consequent link between pay and performance is weak. Table A3 shows the association between salary and total shareholder return. While there is a small positive

[17] As the coefficient is less than one.

[18] The authors wish to thank an anonymous referee for this suggestion.

[19] Although this explanation is not inconsistent with our preferred explanation of retention of high performers, we feel that it likely to be of secondary importance for a number of reasons: firstly, the estimates of pay-performance sensitivity used in this study are annual, suggesting a more immediate adjustment of executive pensions to performance; secondly, the long term link between salary and performance is weak once tenure is controlled for.

Table 6: Survival model estimates for executive exit

	(1) Cox	(2) Gompertz	(3) Exponential	(4) Weibull
Defined Benefit	0.608***	0.630***	0.753***	0.625***
	(-7.72)	(-7.26)	(-4.71)	(-7.37)
TSR	0.587***	0.621***	0.668***	0.581***
	(-5.66)	(-5.28)	(-4.73)	(-5.73)
Log Sales	0.713***	0.730***	0.750***	0.709***
	(-4.52)	(-4.34)	(-4.22)	(-4.60)
CEO	0.812***	0.813***	0.846***	0.818***
	(-4.87)	(-4.85)	(-4.08)	(-4.74)
Male	0.898	0.900	0.925	0.901
	(-1.11)	(-1.10)	(-0.84)	(-1.07)
Age	1.027	1.037	1.001	1.020
	(0.75)	(1.04)	(0.04)	(0.57)
Age Sq	0.999	0.999*	1.000	1.000
	(-1.37)	(-1.66)	(-0.27)	(-1.11)
Board Size	1.216***	1.205***	1.164***	1.213***
	(7.46)	(7.35)	(6.27)	(7.35)
Firm Fixed Effects	Yes	Yes	Yes	Yes
N	4474	4474	4474	4474
Log Likelihood	-25253	-4911	-5215	-4860
Chi-Sq	2594.7	2501.4	1894.3	2575.9

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

1. This table presents the hazard ratios for the four survival models indicated by the column headings.
2. A hazard ratio less than one indicates a reduction in the likelihood of an executive exiting from the firm.

Table 7: Pay, performance and pensions by tenure

Tenure	Salary £000s	Total Pay £000s	TSR	DB	Value £000s	Transfer £000s
< 1	347	1,018	-0.034	0.223	369	1,054
$1-3$	366	1,106	0.039	0.301	321	1,108
$3-6$	376	1,229	0.045	0.355	429	1,376
$6-9$	357	1,140	0.058	0.348	396	1,285
9+	343	1,080	0.059	0.377	454	1,640
Total	359	1,106	0.023	0.303	391	1,264

1. The table presents the mean values of pay, performance and pensions by levels of executive tenure.
2. 'DB' reports the proportion of executives with a defined benefit pension.
3. 'Value' reports the mean annual increase in the transfer value of the defined benefit pension.
4. 'Transfer' reports the mean total transfer value of the defined benefit pension.

Table 8: Firm level performance and the retention of Defined Benefit schemes

	(1) DB	(2) DB	(3) DB	(4) DB
TSR	0.086^{***}	0.045^{***}	0.035^{*}	0.023
	(5.39)	(2.86)	(1.93)	(1.40)
Controls	No	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
Firm Fixed Effects	No	No	No	Yes
N	2334	2243	2243	2243
F-Stat	29.09395	29.01454	24.76116	25.8872
R-Sq	.0123	.145	.197	.229

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

1. This table presents the impact of TSR on the firm level retention of a defined benefit scheme.
2. A linear probability model is estimated, with the dependent variable indicating whether the firm is still operating its defined benefit scheme for the currently serving executives in the firm at time t.
3. t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

association in the raw data (column 1), once fixed effects or a reasonable set of observable controls are included the relationship is statistically insignificant (column 2). This is true both for the control and the treated group (columns 3 and 4).

Column (5) considers the performance sensitivity of final salary against TSR returned over an executive's tenure. Consistent with the absence of a link between salary and performance in the short run, column (5) shows no statistically significant relationship between TSR and final salary. When the career TSR is split at zero to show those that create (destroy) value during their career, a positive relationship is observed for the top performing, value creating, managers. However this relation disappears upon controlling for tenure (column 7). This suggests salary adjustments due to performance are not the principal mechanism driving the pensions-performance sensitivity in the paper.

Pensions and other pay incentives

A final possibility to consider is via the link between pensions and other performance incentive mechanisms. For example, it is possible that executives with defined benefit schemes may feel more comfortably insured for retirement and so might agree to more performance-related terms in their annual remuneration contract. This may then lead to an apparent relation between performance and DB schemes. We find some evidence to support this mechanism in Table 5: the treated group have a higher pay-performance sensitivity than the control group prior to A-day, even when we exclude pensions from total pay (0.158 column (4), row [1]), with this sensitivity dropping slightly (0.136 column (4), row [2]) when this group suffers a reduction in their DB pensions post A-day. However, we observe a much larger decline in performance sensitivity for the treated group once pensions are taken into account.[20]

As a final check, Table A5 examines the reaction of other non-pension elements of pay to A-Day. It finds find no evidence of differential impact between the treated and control group, again suggesting that the changes in pension-performance sensitivity that we observe are due to pensions and not other parts of the compensation package.

7 Conclusion

This paper has sought to identify whether a causal link exists between the provision of executive pensions and firm performance. It does this by exploiting the introduction of the 2006 'A-day' pension-simplification legislation in the UK. Prior to A-day, executive pension benefits were widely used and comprised a significant proportion of the compensation package. The change to the tax law exogenously increased the cost of executive pensions and the terms of contracting over executive pay. This resulted in large changes to executive compensation packages. While defined benefit schemes had already been declining in popularity prior to A-day, there is no doubt that the introduction of A-day significantly accelerated this process, with many executives replacing their defined benefit pension arrangements by other forms of payment.

[20] A more thorough exploration of this indirect link would require additional detailed information on the performance conditions and vesting schedules of the long-term incentive schemes.

The official documents relating to the law change did not mention any anticipated effects in relation to executive incentives, with the intention of the legislation being to simplify the law and impose a cap on tax relief. Nevertheless, we find a strong and negative impact upon the strength of the pay-performance sensitivity among those who were treated by the legislation, which suggests that DB pensions were serving to enhance pay-performance sensitivity prior to A-day in the UK. Just as much of the earlier compensation literature was later shown to have underestimated pay-performance sensitivity because, due to data limitations, they omitted a complete measure of long term incentives (Main et al., 1996; Hall and Liebman, 1998; Hall and Murphy, 2002), our results suggest that pay-performance sensitivity may be underestimated if pension benefits are omitted. For executives who hold sizable DB benefits in the pre-reform era, pay-performance sensitivity would be underestimated by almost one-third. However, with the end of DB benefits in the post reform era, pay-performance sensitivity can be well approximated without pensions data.

We interpret our results as indirect support for the body of literature that views pension benefits as a component of an optimal contract (Edmans and Liu, 2011), and designed to align executive incentives with the providers of a firm's capital. While past research has emphasised incentive alignment with the firm's bondholders (Thanassoulis and Tanaka, 2016), our paper finds an alignment with the firm's shareholders that was adversely affected by the 2006 A-day reform.[21]

By what mechanism could this alignment have operated? We considered four potential mechanisms in this paper: retention of more able directors in firms with DB schemes; the retention of DB pension schemes by high performing firms; the link between final salary and accumulated performance; and the co-existence of pension with performance incentives schemes. Our preferred explanation is that the defined benefit pension served to retain high performing executives. Better performing executives are longer tenured, and such individuals are observed more frequently on a DB pension and have a DB pension of higher value. With each subsequent year on a DB scheme, on average, being more valuable than the last, the incentive of the firm to remove poor performers also increased year on year. A more detailed examination of this mechanism remains for future research.

[21] We do not have sufficient data on bondholders in our sample, so we are unable to confirm whether or not pensions were also acting as inside debt. The contribution of this paper is to demonstrate that defined benefit pensions can play a role in aligning executive incentives with those of their shareholders.

Appendix

A1 Pension provision

A1.1 Determinants

Table A1 presents the determinants of executive pensions. The first four columns are intensive models of, respectively, total pensions, defined benefit pensions (DB), defined contributions (DC), and cash in lieu of pension contributions. The final four columns report the analogous models for the extensive margin (probability of receiving a pension scheme type).

Table A1: 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 NEDs	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
Executive-Firms	4780	4780	4780	4780	4780	4780	4780	4780
Log Likelihood	-49575	-22838	-37197	-14831	-7019	-4823	-8655	-5198
Chi-Sq	1002.7	1464.0	703.8	1234.4	417.5	322.9	517.6	618.8
Censored	3913	13486	9610	16312				
Uncensored	15403	5830	9706	3004				

1. The dependent variable when estimating the intensive margin is specified as ln(1+y), where y is the annual payment under the respective pension type. The dependent variable when estimating the extensive margin is binary, indicating participation in the scheme.

2. Intensive models are estimated using random effects Tobit. Extensive models are estimated using random effects probit.

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

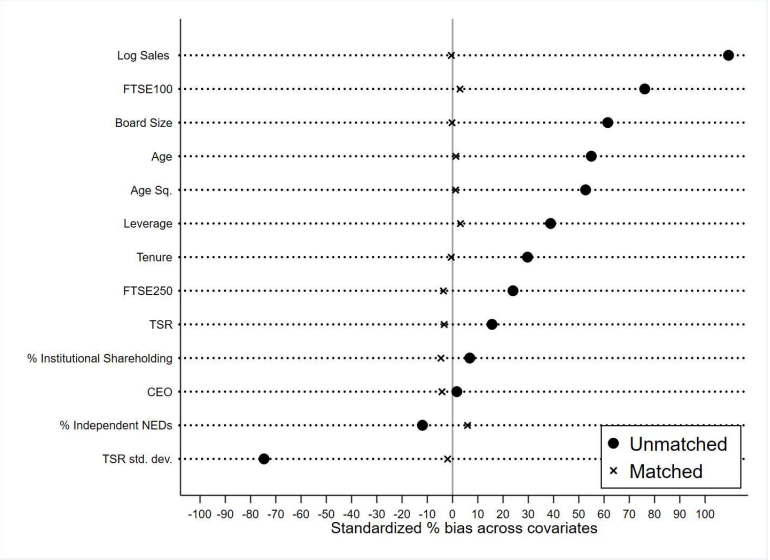
4. All models include executive-firm fixed effects, time dummies, and industry dummies.

A1.2 Robustness of pension change estimates: Matched sample

The DiD methodology used in this study requires that the control and treatment groups are comparable. If the two groups 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 in pay-performance sensitivity could reflect these other differences rather than the effect of A-day itself. We therefore repeat the analysis using a matched sample.

Each treated executive is matched with untreated executives who, based on their observable characteristics prior to the reform, have a similar propensity of treatment. The variables used for matching are the pre-reform executive and firm level characteristics listed in Table A1.

Fig. A1: Bias in Covariate Means for Matched Executives



We use a $k = 5$ 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 to estimate the propensity score for each executive. Executives are excluded if they cannot be matched within the caliper. Figure A1 shows the impact of balancing on the mean of our observable variables. Prior to matching the median bias is 37.4% reducing to 2.1% post matching.

Panel B of table A2 restricts the sample for the DiD to the matched sample. The results in panel B are very similar to those in panel A in terms of magnitude and statistical significance. Therefore we are reassured that our results are not being driven by differences between the type of executive who is treated and the type of executive who is not treated.

Table A2: Robustness of pension changes: Difference-in-Differences with propensity score matching

		Intensive			Extensive		
	Pension	DB	DC	Cash	DB	DC	Cash
	Panel A: Full Sample						
Post 06 × Treated 2006	-0.90***	-1.12***	0.00	1.39***	-0.08***	0.02	0.12***
	(-4.84)	(-6.03)	(-0.02)	(6.27)	(-5.96)	(1.07)	(6.08)
N	19347	19347	19347	19347	19347	19347	19347
Director-Firms	4787	4787	4787	4787	4787	4787	4787
F-Stat	13.2	7.77	8.47	16.2	6.25	7.81	15.7
R-Sq	0.157	0.070	0.065	0.107	0.075	0.055	0.101
	Panel B: Restricted Sample (k=5 NN matching 0.01 Caliper)						
Post 06 × Treated 2006	-0.72***	-1.06***	0.14	1.29***	-0.08***	0.04*	0.11***
	(-3.76)	(-5.52)	(0.63)	(5.68)	(-6.04)	(1.86)	(5.56)
N	13708	13708	13708	13708	13708	13708	13708
Director-Firms	3101	3101	3101	3101	3101	3101	3101
F-Stat	8.13	6.65	6.78	11.2	6.77	6.59	10.8
R-Sq	0.109	0.075	0.046	0.107	0.085	0.039	0.099

1. Panel A reports the difference-in-differences results from the full sample. Panel B restricts only includes observations with a propensity score that can be matched to an appropriate neighbour within a caliper of 0.01.

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

3. All models are estimated controlling for executive-firm fixed effects.

A2 Pay and Performance

The following tables gives the full estimation results of the relationship between pay and performance discussed in section 6.

Table A3: The relationship between salary and performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Annual Salary				Final Salary	
			Control	Treated			
Total shareholder return (TSR)	0.023**	0.004	0.002	0.009			
	(2.57)	(0.68)	(0.26)	(0.78)			
Career TSR					0.003		
					(0.21)		
Value Destroyers						0.020	0.025
						(0.88)	(1.11)
Value Creators						0.079**	0.043
						(2.23)	(1.15)
Tenure		-0.001	0.000	-0.002			0.016***
		(-0.29)	(0.14)	(-0.79)			(2.73)
Log(Sales)		0.076***	0.066***	0.125***			
		(9.92)	(7.54)	(7.71)			
CEO		0.232***	0.224***	0.249***			
		(15.69)	(12.11)	(10.71)			
Age		-0.059*	-0.050	-0.109			
		(-1.68)	(-1.24)	(-1.35)			
FTSE100		0.044**	0.071**	-0.010			
		(2.07)	(2.57)	(-0.30)			
FTSE250		0.035***	0.044***	0.008			
		(2.93)	(3.15)	(0.34)			
σ^{TSR}		0.039***	0.030*	0.051*			
		(2.72)	(1.76)	(1.95)			
Leverage		0.017	0.014	0.064			
		(0.90)	(0.62)	(1.33)			
Board Size		-0.004*	-0.004*	-0.002			
		(-1.91)	(-1.73)	(-0.84)			
% Independent NED's		-0.024	-0.018	0.002			
		(-0.85)	(-0.52)	(0.04)			
% IC Owned		-0.000	-0.000	-0.001			
		(-1.53)	(-0.73)	(-1.22)			
N	18559	17365	12697	4668	2210	2210	2210
Director-Firms		4576	3568	1008			
F-Stat	6.59	22.5	14.6	12.6	38.9	37.1	36.4
R-Sq	0.000	0.036	0.033	0.068	0.378	0.381	0.383

1. This table shows the association between the natural log of salary and measures of shareholder return.
2. Column (1) presents the raw correlation, and column (2) includes observable controls and firm fixed effects. Columns 3 and 4 re-run the specification in column (2) for the control and treated groups separately.
3. Column (5) considers the performance sensitivity of final salary to the TSR returned over an executive's tenure. In columns (6) and (7) Career TSR is split at zero to distinguish between those that create and destroy firm value during their career. Column 7 shows the positive result for value creators in column (6) is not robust to the inclusion of measures of executive tenure.
4. The final salary models contain additional career average controls, not reported.

Table A4: Robustness checks for the impact of A-day on pension-performance sensitivity

	(1) Raw	(2) +Controls	(3) +2011 Reform	(4) +Pre Trends	(5) Matched Sample	(6) CEOs Only	(7) -Post 2008	(8) -CEOs and 2008
Treated Pre [1]	0.237***	0.227***	0.227***	0.156***	0.218***	0.252***	0.204***	0.231***
	(5.92)	(5.64)	(5.66)	(4.07)	(5.37)	(3.82)	(5.18)	(3.50)
Treated Post [2]	0.082***	0.111***	0.104***	0.075***	0.109***	0.068	0.158***	0.111
	(3.41)	(4.32)	(3.92)	(3.09)	(3.45)	(1.50)	(3.92)	(1.37)
Difference [2] - [1]	-0.155***	-0.116**	-0.123***	-0.081*	-0.109**	-0.184**	-0.046	-0.121
	(-3.39)	(-2.45)	(-2.58)	(-1.82)	(-2.15)	(-2.35)	(-0.82)	(-1.17)
Control Pre [3]	-0.054***	0.035	0.049**	0.013	0.034	0.026	0.041*	0.039
	(-2.76)	(1.64)	(2.11)	(0.71)	(1.55)	(0.56)	(1.93)	(0.85)
Control Post [4]	0.096***	0.119***	0.138***	0.091***	0.124***	0.119***	0.208***	0.174***
	(7.96)	(8.18)	(7.70)	(7.38)	(7.63)	(5.02)	(9.57)	(5.05)
Control Difference [4] - [3]	0.150***	0.084***	0.089***	0.078***	0.090***	0.093*	0.166***	0.136**
	(6.52)	(3.31)	(3.44)	(3.49)	(3.45)	(1.77)	(5.43)	(2.17)
DiD ([2]-[1]) - ([4]-[3])	-0.305***	-0.199***	-0.211***	-0.159***	-0.200***	-0.276***	-0.213***	-0.256**
	(-5.95)	(-3.95)	(-4.16)	(-3.21)	(-3.70)	(-3.17)	(-3.76)	(-2.38)
N	18125	18125	18125	18125	13217	5341	12333	3461
Director-Firms	4595	4595	4595	4595	3075	1416	3875	1171
F-Stat	36	25.1	21	40.7	23.8	9.18	24.3	10.1
R-Sq	0.019	0.078	0.078	0.078	0.094	0.082	0.088	0.101

1. This table checks the robustness of our main set of results.

2. Columns (1) and (2) repeat our preferred specifications from table 4; Column (3) includes the 2011 reduction of the allowance in the treatment; Column (4) controls for possible divergent trends pre A-day; Column (5) applies propensity score matching; Column (6) includes CEOs only; Column (7) excludes the financial crisis; Column (8) excludes both CEOs and the financial crisis.

Table A5: Non-pension pay performance sensitivity to A-Day

	(1) ln Salary	(2) ln Bonus	(3) ln LTI	(4) ln Other
Treated Pre [1]	0.036	2.139***	-0.254	0.216
	(0.18)	(4.73)	(-0.63)	(1.00)
Treated Post [2]	0.068	2.435***	0.362	0.000
	(0.52)	(10.32)	(1.41)	(0.00)
Difference [2] - [1]	0.033	0.296	0.616	-0.216
	(0.14)	(0.60)	(1.33)	(-0.88)
Control Pre [3]	-0.246**	1.264***	0.478**	-0.085
	(-2.08)	(7.14)	(2.45)	(-0.77)
Control Post [4]	0.107	1.939***	0.469***	0.054
	(1.44)	(15.94)	(3.86)	(0.87)
Control Difference [4] - [3]	0.354**	0.675***	-0.009	0.138
	(2.54)	(3.28)	(-0.04)	(1.12)
DiD ([2]-[1]) - ([4]-[3])	-0.321	-0.379	0.625	-0.354
	(-1.22)	(-0.73)	(1.28)	(-1.35)
N	19347	19347	19347	19347
Director-Firms	4787	4787	4787	4787
F-Stat	7.55	27.6	11	5.23
R-Sq	0.019	0.068	0.029	0.016

1. This table examines the pay-performance sensitivity for the treated and control groups before and after A-day for non-pension elements of executive remuneration.
2. LTI (column 3) are 'long term incentives' and comprise the aggregate of the grant date value of executive share options and any other equity incentives, with or without vesting conditions, awarded during the year.
3. The column 'other' represents all other cash payments including payments for executive expenses, housing, travel and relocation payments.

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