UK Executive Stock Option Valuation: A Conditional Model

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Abstract

We value UK executive stock options (ESOs) as American on European options conditional on the probability of the holders achieving some performance criteria. Unlike the standard Black and Scholes (BS) model, which is universally used both in the literature and practice, this provides a more realistic representation of UK ESOs. We show that UK ESOs actually have less value and contain more incentives than they appear under the BS approach. Specifically, we observe an 18% average discount in the value of the ESOs when compared to their BS value. In addition, we find a significantly higher incentive level when the pay-performance sensitivity (PPS) is measured with our model. Furthermore, we observe significantly higher corporate performance among CEOs with higher PPS under the conditional valuation than the BS approach. This implies that our model captures ex-post performance related incentives beyond the BS approach. We argue that these findings have implications for two contemporary debates in the UK, i.e. the substitution of ESOs by Long-Term Incentive Plans (LTIPs) and the discounting of ESO value from company profits.

Introduction

Executive Share Options (ESOs) have attracted much controversy in recent years. During the early 1990s they were hailed as the most effective tool for relating executive pay to corporate performance and aligning the interests of managers and shareholders. This resulted in the widespread use of ESOs on both sides of the Atlantic. According to Hall and Liebman (1998), stock options have emerged as the single largest component of compensation for U.S. executives. In fiscal year 1998, the grant-date value of stock options accounted for 40 percent of total pay for S&P 500 CEO's, up from only 25 percent of total pay in 1992. Almost the same figures apply for high market capitalisation, well-established UK firms (Conyon and Schwalbach, 1997). Conyon, Gregg and Machin (1995) also pinpointed a marked increase in the use of share incentive schemes or share options, during the 1990s, for a wide range of UK companies.

In recent years though, ESOs have been accused of over-rewarding managers. In the UK, policy makers have started calling for the replacement of ESOs by long-term incentive plans (LTIPs), which typically consist of restricted shares (Greenbury, 1995). These recommendations have been supported by both institutional inventors and the financial press (see Stathopoulos *et al.*, 2004a for more details) and as a result there is a notable shift from ESOs to LTIPs especially for well-established, high market-capitalisation firms that typically attract more public scrutiny (Monks Partnership, 1996). In addition, the academic community has always been hesitant to accept ESOs as the panacea to the agent-principal problem. The reasons for that have both practical and theoretical grounds. On a practical level, the empirical results produced by various studies have suggested a weak link between executive pay packages (including stock options) and corporate performance and often contradictory results have been presented (for a review see Murphy, 1999). In any case, increases to pay-performance sensitivity during the 1990s appear to be largely a phenomenon associated with large companies (Murphy, 1999). On a theoretical level, several academics have argued that both the type of options used and the valuation methods applied are inappropriate. Bebchuk *et al.* (2002) argue that the "plain-vanilla"[1] type of options, which are the most commonly used, do not provide the best incentives to

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[1] European type options, with pre-set, unchangeable exercise price usually offered at-the-money.

executive and are the result of arm's length relationships between management and remuneration committees. In line with this argument, Meulbroek (2001a) and Johnson and Tian (2000) have produced models of "Indexed" stock options and argued that they provide better incentives.

The Black and Scholes (1973) model is the most commonly applied ESO valuation approach of both practitioners, i.e. consultants and remuneration committees, and academics (for UK research see: Stathopoulos *et al.*, 2004b; Conyon and Sadler, 2001; Conyon and Murphy, 2000; Conyon *et al.*, 2000; Main *et al.*, 1996). As Murphy (1999) argues, the Black and Scholes formula measures the value of a standard, trade-able European option for a well-diversified investor that can hedge away the risk of this option. Nevertheless, executive stock options are not trade-able, can be exercised early and are usually forfeited if the director leaves the company. In addition, they are given to directors that cannot short-sell the shares of their companies and have all their human capital tied up with the company. Murphy (1999) also notes that the Black and Scholes formula ignores the possibility of timing of exercise based on directors' private information. Previous attempts to address some of these shortcomings of the BS model have focused on the un-diversification and un-tradability of ESO portfolios in the US (Meulbroek, 2001b; Core and Guay, 2001). In the UK, ESOs are attached with certain performance criteria at the end of an initial vesting period; whether or not the ESOs become exercisable after the vesting period depends on the satisfaction of these criteria. This unique feature of them renders the use of Black and Scholes formula to value ESOs in the UK even less appropriate than their US counterparts. However, few studies seek to highlight this issue[2].

This paper attempts to address the issues mentioned above. First, we argue that UK ESOs cannot be considered as "plain-vanilla" options; therefore the criticism directed to that kind of options is not applicable for UK ESOs. We also argue that since they are not "plain-vanilla" options, they should not be valued as such (by using the BS model). In this direction, we devise a new valuation model tailored for UK ESOs. Our model is superior to the standard BS model in the sense that it allows for

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[2] A notable exception is the paper by Conyon *et al.* (2000). This study does not provide an alternative model but it is a first attempt to provide a thorough overview of the existence and importance of the performance criteria attached to UK ESOs.

the early exercise of the option and takes into account the existence of performance criteria. We show that a commonly adopted assumption in the literature, namely that the performance criteria attached to UK ESOs are not binding (therefore there is no need to discount the BS option value) is incorrect. This finding has implications for the validity of all the previously mentioned empirical research conducted on a UK sample. We also demonstrate that UK ESOs provide less value and more incentives than indicated by the BS approach. Furthermore, these "extra" incentives contain important information beyond those captured by the BS approach and are associated with higher subsequent corporate performance.

Our study contributes to two contemporary debates over executive rewards in the UK. Firstly, the observation that UK ESOs provide higher incentives than previously thought, questions the arguments against ESOs as put forward by market participants, i.e. institutional investors, and policy makers. We argue that the recommendation to move from ESOs to LTIPs could be contributed by the mis-valuation of UK ESOs. Secondly, the observation that the BS approach systematically overvalues the UK ESOs suggests that it will impose a downward bias to the reported profits of UK companies, following the IASB recommendation to recognise ESOs as an expense from January 2004 onward. Hence, the current corporate practice of calculating the fair value of ESOs using the BS model might not be appropriate. The potential difference in reported profits for UK companies using our conditional model to estimate this expense will be substantial, especially for large companies that tend to award ESOs worth several million pounds.

The paper is organised as follows: Next section presents our model. Section 3 describes the data and methodology applied to this study. Section 4 presents our results and section 5 our conclusions.

The Conditional Valuation Approach

The typical ESO issued by UK companies is best illustrated in Figure 1. It is a conditional compound option, with the conditions, i.e. performance criteria, lying at the end of a vesting period. This means that UK managers are not awarded the options immediately; instead they are awarded a right to obtain the options at the end of the vesting period T_V, typically 3 years, subject to their performance meeting some benchmark criteria. This right represents a new type of option, which we call an executive option. If their performance, at the end of the vesting period, satisfies the criteria set they are awarded American-type options, which expire at time T (see Fig 1). The existence of these performance criteria has been documented by Stathopoulos *et al.* (2004b), Conyon and Murphy (2000), Conyon *et al.* (2000) and others. These conditions could vary from accounting based to relative-performance market based criteria.
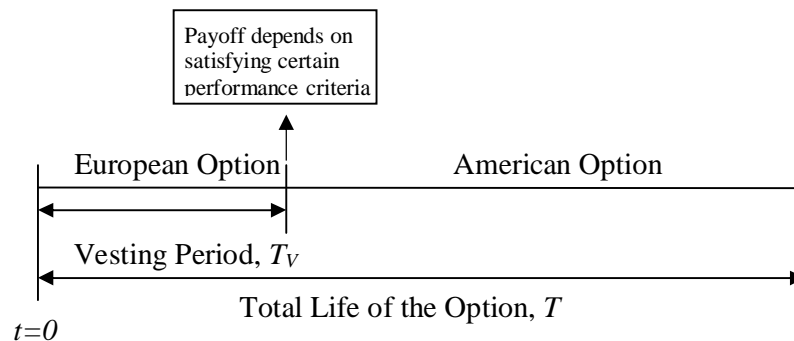

Fig. 1: Typical Executive Stock Option issued in the UK

By denoting as *S* the share value and *K* the exercise price of the option, at time *T* the payoff of the awarded American option is $A_T(S_T) = \max(S_T - K, 0)$. The first step in estimating the value of the executive option is to derive the value A_{T_V} of the American option at $t = T_V$. At $t = T_V$ the executive is awarded the American option, subject to successfully satisfying certain performance criteria. We assume that the level of the stock price at T_V depends on the performance of the executive up to that point and thus the probability of him successfully meeting the criteria depends on where the stock is in the expected range of prices. More specifically, assuming that

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the stock has a lognormal distribution it follows that $\ln S_{T_V} \sim N(m, s^2)$, where N is the Normal distribution, $m = \ln S_0 + (r_f - d - s^2/2)T_V$, $s = s\sqrt{T_V}$ with S_0 being the stock price at $t=0$, r_f the risk-free rate, d the dividend yield, and s the volatility of the stock. We split the possible range of values of the stock into 10 different ranges based on probabilities by defining as X_a, $a = \{90\%, 80\%, ..., 10\%\}$, the stock level for which it holds that $P(S_{T_V} \le X_a) = a$. Furthermore, we assume that $X_{0\%} = 0$ and $X_{100\%} = +\infty$. At this point we define the payoff of the executive payoff at $t = T_V$ as $EO_{T_V}(S_{T_V}) = (a+5\%)A_{T_V}(S_{T_V})$, for $X_a \le S_{T_V} \le X_{a+10\%}$. In effect we are assuming that if the share price is for example above $X_{90\%}$ the company is performing very well and the executive has a 95% probability of being awarded the American option. In a similar way if the share price is below $X_{10\%}$ the probability of him being awarded the options is only 5%. Finally, based on the payoff $EO_{T_V}(S_{T_V})$ the value of the executive option at $t=0$ is found by discounting the expected value under the risk-neutral probability measure, $EO_{t=0} = e^{(-r_f T_V)}E_{t=0}[EO_{T_V}(S_{T_V})]$.

The improvement of our model to the proper valuation of UK ESOs is threefold. First it takes into account the two-stage maturity of the ESOs. The vesting period is treated as a European option and the rest of the option's lifetime as an American. Second, because it treats the second stage as an American option it allows for the early exercise of the ESO. Third, and most importantly, it takes into account the probability of meeting the performance criteria attached to UK ESOs. The probabilistic function allows for the incorporation of performance criteria in generic terms. In other words, we do not restrict ourselves to particular performance criteria. Instead, we only calculate the probability of meeting some criteria based on the market performance of the company. As mentioned earlier, the performance criteria can range from accounting based to relative-performance market based. That makes the incorporation of the actual criteria into a generic valuation model extremely difficult and complicated. The extra assumption we take in order for our model to work (this happens only in the cases where the actual performance criteria are

accounting based) is that the company's accounting performance is correlated to its market performance[3].

Data and Methodology

We use hand-collected data on 6,169 option grants given to CEOs and other executive directors of UK companies. Each year between 1996 and 1998, we stratify the London Stock Exchange (LSE) into high, middle, and low performers based on companies that are available in London Share Price Database (LSPD).[4] Companies from the financial sector, companies that have less than 24 observations and also those with no observations throughout the year investigated are excluded from the analysis. We sort the stocks each year by two criteria, i.e. the logarithmic raw returns and cumulative abnormal returns. We compute abnormal stock return based on the market model estimated 48 months before the current year. The high (low) performers are selected from the intersection of the top (bottom) 50 companies in these criteria. The middle performers are selected from the intersection of the middle 200 companies in these criteria. We record the option portfolios of the directors in the sampled companies for the past one year, current year, and subsequent 2 years. Hence, the sample covers the period of 1995 to 2000. This four year window allows us to control for any temporary changes in the granting policies. Information on option grants, (for both new and old grants) comprising numbers of options, exercise price, grant date, vesting period and duration, was collected from the companies' annual reports, accessed either directly from the companies, through Companies House or the Companies Fact-finder database. [5]

We calculate the grant date value for each option grant with both our model and the Black-Scholes one. Apart from the readily available parameters, i.e. exercise

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[3] Assuming that the efficient market hypothesis holds, price leads earnings. When the share price is drawn from the upper range of the possible price distribution, it indicates an increase in the value of the company. That increase is related, under the assumptions used by any DCF equity valuation model, to either increase in earnings performance or decrease in the cost of capital. We argue that since the vesting period is typically limited only to 3 years, the change in earnings performance will have a greater impact on company value than the change in cost of capital.

[4] The number of companies available from the LSPD is 1,831, 1,990 and 1,744 for years 1996, 1997, and 1998 respectively.

[5] A number of companies were excluded for the following reasons: four companies went into administration after the performance shock, three companies were dissolved after the performance shock, and for two companies no data could be found. In addition, 35 stock option grants are not included in the analysis since full details on the grant date and exercise price were not disclosed.

price and option maturity, which we gather directly from the annual reports, we collect the other inputs from Datastream. These include: the spot price, which is the closing share price on the day of the issuance of the option unadjusted for any subsequent capitalisation changes; the dividend yield, which is computed as the average of the prior 48 monthly observations on cash dividend per share; the risk free rate (average yield on 7-year government bonds); and the stock volatility, calculated as the standard deviation of monthly continuously compounded returns over the prior 48 months multiplied by the square root of 12 (to annualise).

In order to estimate the incentive levels, we calculate the pay-performance sensitivity (PPS) measure. We use the "effective" ownership measure as described in Conyon and Murphy (2000, F657-F658):

Pay-Performance Sensitivity = (Shares Held as a % of Firm Shares) + (Options Held as a % of Firm Shares * Option Delta) + (LTIP Shares as a % of Firm Shares * LTIP Delta)   (1)

This measure of direct incentives estimates only the incentives that stem from equity based compensation. It has been established in the literature that equity-based incentives constitute the vast majority of managerial incentives (Murphy, 1999). Therefore this measure is a good proxy of total managerial incentives. It is estimated by the percentage ratios of shareholdings, stock options and restricted stock on outstanding shares. A value of 1 indicates that the director's pay will increase by 1% for every 100% increase in shareholder wealth. In order to calculate the stock options ratio, the number of stock options is multiplied by the options' delta (d, hedge ratio) in order to produce the shares' equivalent number. We calculate both our model's and BS hedge ratios[6] so we can see the effect of our model to the PPS measure and estimate the differences between the PPS based on the two valuation approaches, i.e. the conditional-PPS and the BS-PPS. As far as the LTIP delta is concerned, we follow current practice and set it universally to one (see for details: Conyon, Murphy, 2000; F657).

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[6] In order to calculate the hedge ratio of the conditional valuation approach we follow the BS practice. Therefore we define it as the partial derivative of the conditional value with respect to the stock price.

Finally, we investigate the empirical relationship between incentives and corporate performance specifically for the CEOs using logistic regressions. The CEO sub-sample consists of 490 company-year observations. Specifically, we regress a PPS-difference dummy on industry median adjusted variables including market-to-book value, return on total asset, and operating cash flows. These company performance proxies are measured in the past 1 year, current year, or subsequent 1 year. To control for company size, we also include current year log market capitalisation as independent variable. The PPS-difference dummy is set to 1 for observations where the conditional-PPS value is greater than the BS-PPS and 0 otherwise. In cases where the conditional-PPS has higher (lower) value than the BS-PPS, CEOs' incentives are under- (over-) estimated by the conventional BS valuation approach. The market-to-book value captures the growth potential of the companies relative to the sector. The return on total assets measures the profitability of the company. The operating cash flow proxies the financial slack of the company. We use the industry median to adjust these variables in order to extract the company performance relative to their competitors in the same sector.

Empirical Findings

The valuation of ESOs with the conditional model renders some interesting results. The conditional model allows the early exercise of the option (American-type option after the vesting period), which according to the theory increases the value of an option; the introduction though of the performance criteria in the model reduces the overall estimated value of the ESOs. In particular, the average decrease in the value of the 6,169 options grants is 18% (median 19%), significant at 1% level. This means that the option value, calculated by our model, is on average 18% lower than the BS value. Figure 2 provides a histogram of the percentage differences in the ESO values as estimated by the two models. This result has several implications.

(Add Figure 2 Here)

First, it shows that both academics and practitioners have been constantly overvaluing the options granted to UK executives. As a major factor for this we identify the inability to properly model UK ESOs and in particular the presence of

performance criteria, which are attached to the options. Taking into account the huge controversy and debate over the level of executive pay and in particular of ESOs this finding could create a new dimension to the debate and alter long standing positions of policy makers and other market participants, e.g. institutional investors.

Second, this result challenges a common assumption in the literature that the performance criteria are not binding and therefore have no effect on the value of ESOs (Conyon and Murphy, 2000; F645). The majority of the studies on UK data have taken the arbitrary decision to discount LTIPs by 20% for performance-contingent grants (for example Conyon and Murphy, 2000; Stathopoulos *et al.*, 2004b). This discount level has been estimated on subjective grounds and as far as we are aware no UK study has extended it to ESOs. In this paper we demonstrate that this level of discounting is appropriate for ESOs; still the jury is out for LTIPs.

A third implication of this result stems from the accounting treatment of ESOs in the UK. As mentioned in the introduction of this paper, as of January 2004, UK companies have to recognise as an expense ESOs and deduct their fair value from reported profits. Our result indicates that UK firms could reduce this expense by 18% on average, simply by calculating the grant date value of the newly granted options by our model. The cumulative BS value of the new option grants in our database is £38m per year. This indicates that our sample companies could increase, on average, their cumulative reported profits by £6.8m per year.

In addition to the value miscalculation, we test to see whether there is also misperception on the level of incentives created to UK directors by their ESOs. We test that on the sample of CEOs we have in our database. We calculate the pay-performance sensitivity using the "effective" ownership measure described in the previous section. Table 1 shows the results. The average PPS, estimated with our model, is 4.43% (significantly different than zero at the 1% level), whereas the average BS-PPS is 4.30% (significant at 1%). The difference between the two means is 0.13% and also significant at the 1% level. This result indicates that the "true" incentive level provided by UK ESOs is marginally higher than previously thought.

(Add Table 1 Here)

So far we have demonstrated that there are fundamental misconceptions regarding UK ESOs. The better modelling of the options, granted to UK executive directors, highlights that the ESOs are less costly to the companies that issue them and provide greater incentives to their holders. In light of this evidence the arguments in favour of LTIPs become even weaker. As mentioned earlier, the UK market participants are lately pushing towards the replacement of ESOs by LTIPs. LTIPs in the UK are typically restricted shares, provided to directors on the condition of meeting certain performance criteria. In other words, they are like ESOs with an exercise price though set to zero. Setting up the exercise price to zero makes cashing in easier for directors, thus decreases the level of incentives. Therefore, we believe the recommendation to shift from ESOs to LTIPs should be revisited. More scope should be given into the better modelling of UK ESOs.

The question that remains unanswered is whether the weak pay-performance link identified in the literature is also a result of applying an inappropriate model to value important elements of the executive package, such as the stock options. We now turn to this issue. Table 2 shows the result from the logistic regression of the PPS-difference dummy variable on proxies of corporate performance measured in the past 1 year, current year, and subsequent 1 year based on the sub-sample of CEOs. Since the PPS-difference dummy variable is defined as 1 when the conditional-PPS is higher than the BS-PPS and 0 otherwise, it classifies the CEOs' incentives into two groups, i.e. those that are underestimated (1) and overestimated (0) by the simple BS approach relative to the conditional approach. In Table 2, notice that the PPS-difference dummy does not show significant relationship with the market capitalisation (MV) control variable as well as ex-ante, current, and ex-post market-to-book value (MB). This implies that there is no significant difference in size and growth opportunities of companies managed by CEOs whose incentives are either under- or overestimated by the BS approach.

Table 2 further shows that in the past 1 year and current year, the two groups of companies do not have significant difference in profitability as captured by return on total asset (ROA). In terms of financial slack as proxied by operating cash flow (OCF), there is a marginally significant difference between the two groups.

Companies with CEO whose incentives are underestimated by the BS relative to the conditional valuation approach are associated with higher financial slack in the past and current year of the PPS estimation. This finding suggests that companies managed by CEOs with higher incentives than it appears from the BS approach are also those with higher internal financing capability. Since these companies are less dependent on external financing, they enjoy greater flexibility in competing for investment projects. Finally, Table 2 shows that in the year subsequent to the PPS estimation, the relationship between PPS-difference dummy and the ROA is positive and statistically significantly at 5% level. This indicates that companies managed by CEOs whose incentives are underestimated by the BS approach enjoy higher profitability in the subsequent year. Recall that this same group of companies are also associated with higher ex-ante financial slack. This implies that companies managed by CEOs with higher conditional-PPS than BS-PPS are able to translate the ex-ante financial slack into ex-post profitability. Hence, we demonstrate that the difference between the two valuation approaches in measuring executive incentives does contain information linked with subsequent corporate performance. It implies that the conditional approach indeed captures ex-post performance related incentives beyond the BS approach, which deserves further study.

However, this finding still does not provide direct evidence of a positive relationship between PPS and subsequent performance. Unreported results show that subsequent corporate performance has no significant association with the PPS level itself measured either by the conditional or BS valuation. The lack of significant evidence of pay-performance link in the UK is largely consistent with the findings of existing literature. Previous studies have reported very small pay-performance sensitivities for UK CEOs (Conyon and Murphy, 2000; Conyon *et al.* 2000). In particular, the PPS of CEOs in large UK firms, reported in these studies, is typically below 1% and only a fraction of the PPS enjoyed by US CEOs. These findings, together with our results, lead us to the conclusion that the weak relationship between pay and performance in the UK is basically attributable to policy/practice and not miscalculation. In other words, there is no significant link because UK firms decide not to offer "high-incentive" pay packages.

Conclusions

This paper revisits the valuation issue of executive stock options (ESOs) with the particular scope of appropriately modelling UK ESOs. Our model represents UK ESOs as conditional compound options. They are American on a European type options with the satisfaction of certain performance criteria operating as the condition for the options to vest. We believe that this model is a more realistic representation of UK ESOs than the standard Black and Scholes (1973) model, which is universally used in the literature.

We find that UK ESOs have less value and contain more incentives than previously thought. In particular, we observe an 18% average discount in the value of the ESOs when compared to the BS value. In addition, we detect a significantly higher incentive level, when the pay-performance sensitivity is measured with our model. We also find that the extra incentives, identified by our model, i.e. the difference between the conditional-PPS and BS-PPS, are positively related to future corporate performance. This implies that our conditional valuation approach contains information relevant to future performance that is not captured by the BS approach.

Finally, our findings have two key contributions. First, the IASB (2003) recently requires UK companies to discount ESO values from their reported profits. The fact that the BS approach systematically overvalues ESOs relative to our conditional approach at the grant date implies that it is not an appropriate valuation model for this purpose. As shown earlier in this paper, UK companies have material interest to change the ESO valuation method. This will allow them to improve the level of profits reported under the current practice. Second, there is growing interest in using the LTIPs to substitute ESOs due to the assumption that the latter remuneration tool results into the over-rewarding of directors and a weaker alignment of interests between agents and principals. Our results indicate that this assumption is based on a misconception and mis-valuation of UK ESOs. We argue that moving into a remuneration scheme that allows directors to cash in easier (since LTIPs in the UK are like ESOs with zero exercise prices) will further weaken the link between executive pay and corporate performance.

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Figure 2: Histogram on the percentage differences between the conditional and BS models

This histogram shows the distribution of the percentage difference in individual UK executive stock option value between the conditional and the BS approach at grant date. The sample consists of 6,169 observations over the period of 1995 to 2000.

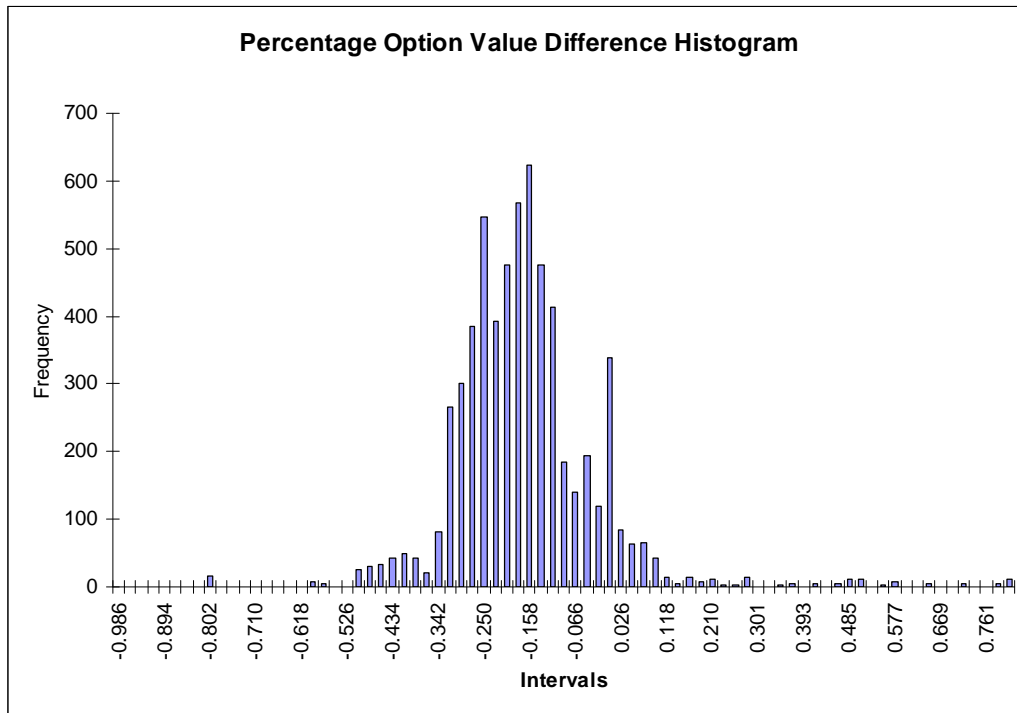**Percentage Option Value Difference Histogram**

Table 1 Descriptive statistics of the difference between conditional-PPS and BS-PPS of the CEO sub-sample.

This table shows the descriptive statistics of the sub-sample of CEO stock based pay performance sensitivity in the UK, which includes 490 CEO-year observations over the period of 1995 to 2000. It shows the mean, t-statistics of the mean, median, and standard deviation of the conditional-PPS, BS-PPS, and their difference.

	Mean	Median	St. Dev.
Conditional-PPS	4.43% (6.992)	1.10%	13.50
BS-PPS	4.30% (6.817)	1.00%	13.50
Difference in PPS	0.13% (3.119)	0.10%	0.90

Table 2 Logistic regression of PPS difference dummy on company performance

This table shows the coefficients (*p*-values) from the logistic regression of PPS-difference dummy on log market capitalisation (MV), which serves as a control variable, and proxies of corporate performance including market-to-book value (MB), return on total asset (ROA), and operating cash flow (OCF). The PPS-difference dummy variable is set to 1 when conditional-PPS > BS-PPS and 0 otherwise. The corporate performance variables are measured in the past 1 year, current year, and subsequent 1 year relative to the PPS estimation year. The analysis is conducted on a sub-sample of CEO stock based pay packages in the UK, which includes 490 CEO-year observations over the period of 1995 to 2000.

Intercept	MV_t	MB_{t-1}	ROA_{t-1}	OCF_{t-1}	MB_t	ROA_t	OCF_t	MB_{t+1}	ROA_{t+1}	OCF_{t+1}	Adj R^2	Wald X^2
1.33 (0.00)	0.00 (0.89)	0.00 (0.54)	0.02 (0.98)	1.74 (0.10)							0.04	10.86
1.27 (0.00)	0.00 (0.97)				0.00 (0.91)	0.32 (0.60)	1.36 (0.09)				0.02	7.33
1.30 (0.00)	0.00 (0.91)							0.00 (0.19)	2.86 (0.02)	-1.32 (0.25)	0.03	9.72