Managerial Risk Incentives and Investment Related Agency Costs

Yacine Belghitar, Cranfield U

Ephraim Clark, Middlesex U. Business School

Forthcoming in International Journal of Financial Analysis

Abstract

We assess the impact of compensation based incentives together with monitoring mechanisms on investment related agency costs. The results indicate that well structured compensation based incentives significantly reduce agency costs. Managerial firm based wealth delta has a significant, negative effect on agency costs for firms in all size categories. The significance of managerial firm based wealth vega in reducing agency costs is concentrated in small firms, suggesting that vega exposure is more effective where risk is higher. The significance of cash compensation in reducing agency costs is concentrated in the large firms. This result implies that higher cash compensation reduces agency costs by allowing risk-averse managers the opportunity to diversify outside the firm.

Keywords: corporate governance, executives compensation, risk incentives, delta, vega.

1. Introduction

This study provides evidence that well structured compensation based incentives significantly reduce investment related agency costs. The potential conflict of interest between shareholders and professional managers in large publicly traded corporations is a major issue in the study of corporate governance. Rooted in the separation of power between the shareholders that own the firm and the managers that control the firm's assets, this well known agency conflict arises from fundamental differences in the positions of shareholders and managers. Whereas shareholders are in a position to readily diversify their wealth, managers typically have most of their human capital tied up in the firm and often hold a large proportion of their financial wealth within the firm as well (Fama, 1980; Stulz and Smith, 1985). This principal-agent conflict gives rise to agency costs that lead to the sub-optimal use of a firm's resources. Under-diversified, risk-averse managers have an incentive to reduce their personal exposure by undertaking investments that reduce firm risk or by foregoing risky positive net present value projects at the expense of shareholders in the form of reduced wealth creation. As Jensen (1986) has noted, this problem is likely to be acute in firms with low growth opportunities and high free cash flow.

The conventional remedy for this conflict is to align managerial interests with those of shareholders by tying the manager's compensation to firm value or firm performance (e.g. Jensen and Meckling, 1976). Option based compensation is well suited to this end because the convex payout profile of stock options can offset the concavity in the manager's utility function. In practice, the use of option based compensation has been increasingly employed since the latter part of twentieth century (Murphy, 1999 and Brockman, et al., 2010). For example, Murphy (1999) observes that stock options have become the largest single component of compensation over the last

fifteen years and Hall et al. (2002) note that stock options constitute the single largest part of the compensation packages of US CEOs. Similarly, Conyon *et al*. (2011) find that during the period 1997-2003 the importance of salaries in total compensation has declined for UK CEOs, while bonuses and equity related pay, such as options have become more important. As discussed in the following section, there is a long and growing literature examining the determinants and incentive effects of managerial compensation on agency costs. Surprisingly, despite this and the growing use of stock and stock option compensation, there has been no attempt in the literature to measure investment related agency costs directly and test if and how they are impacted by option based compensation incentives.

This paper addresses this gap by first explicitly measuring the investment related agency costs on a broad sample of UK firms, and then assessing if and how managerial compensation based incentives affects them. A UK sample is of particular interest because prior UK studies have documented that internal corporate governance monitoring mechanisms, such as board structure, are not effective in reducing agency costs (e.g. Goergen and Rennebog, 2001). In the absence of effective internal monitoring mechanisms, compensation based incentives offer themselves as a credible alternative. They have the potential to mitigate suboptimal managerial behaviour and, hence, to reduce agency costs. To test this argument, we employ two analytical parameters of option-based compensation risk-taking incentives, namely delta and vega. Delta measures the sensitivity of the manager's firm based wealth to the firm's stock price while vega captures the manager's firm based wealth sensitivity to the firm's stock return volatility.[1]

[1] The delta of outright share ownership is 1 and the vega is 0. The delta and vega of cash are both equal to 0. The delta and vega of managerial total firm based wealth are weighted averages of the deltas and

Another important feature of this paper is that it recognizes that firm size can affect the effectiveness of compensation incentives on managerial behaviour. It is generally held that due to greater complexity and difficulty in monitoring, managerial actions are less observable in large firms (Doukas, et al., 2005; McKnight and Weir, 2009). Where managerial actions are less observable, managers could utilise this cover to pursue conservative corporate policies at the expense of shareholders. In this kind of environment compensation based incentives could be very effective in mitigating the agency conflict. Managers in small firms do not have this cover, but the agency conflict is exacerbated by the financial vulnerability of small firms due to their limited access to human and financial resources (e.g. Titman and Wessels, 1988). Thus, if larger firms are conducive to covering managerial actions and smaller firms are more financially fragile, the effect of compensation incentives may vary across the large-small environment.

In the main contribution of this paper the results show that managerial compensation incentives do have a significant effect on investment related agency costs, and that the effects do vary with respect to large and small firms. Managerial wealth delta is significantly, negatively related to agency costs for both large and small firms. This suggests that managerial compensation packages with high sensitivity to the firm stock price reduce agency costs. The results also show that cash compensation is significantly, negatively related to agency costs for large firms but not small ones. This is consistent with Guay's (1999) argument that higher cash compensation reduces agency costs by affording risk-averse managers in large firms the opportunity to

---

vegas of the individual shareholdings and options: $delta = \sum_i x_i \, delta_i \quad vega = \sum_i x_i \, vega_i$, where *i* refers to the individual shareholdings and options and x_i is the proportion of asset *i* in total firm based wealth. For example, consider a manager with 50% of his wealth in shares and 50% in an option with a delta of 0.5. The delta of his portfolio will be equal to $0.5 \times 1 + 0.5 \times 0.5 = 0.75$.

diversify outside the firm. Finally, managerial wealth vega significantly reduces agency costs in small firms but not in large ones, suggesting that vega exposure is more effective where risk is higher.

2. Previous related work

Jensen (1986) argues that firms with free cash flow and low growth prospects are prone to agency costs. Within the free cash flow hypothesis, it is generally assumed that managers pursue self interest at the expense of shareholders. As such, the presence of cash flow in excess of that required to finance new value investments creates the potential for those funds to be wasted (Richardson, 2006). There is evidence in the compensation literature that managerial compensation incentives affect corporate policy by aligning the managers' interests with those of the shareholders (Guay, 1999; Knopf, et al., 2002; Coles, et al., 2006; Brockman, et al., 2010). The implication is that the compensation incentives reduce agency costs. This compensation literature has used one form or another of three variables to capture managerial compensation incentives: Delta, vega, and cash compensation.

2.1 Delta and agency costs

Coles, et al. (2006) highlight that delta may serve to align the interests of shareholders and managers by providing management with incentives to work harder or more effectively in order to share gains/losses with shareholders. Therefore, a negative relationship would be expected between delta and agency costs. Alternatively, Chava and Purnanandam (2010) argue that the incentive to share gains with shareholders imposes a cost on management. This cost is inherent in the form of increased exposure to the firm's total risk, which would be of concern to an undiversified risk-averse manager, as a manager's wealth is typically concentrated in the firm. Furthermore,

managerial human capital is closely associated with firm performance (Fama, 1980; Smith and Stulz, 1985; Chava and Purnanandam, 2010). Therefore, managers with higher delta exposure would be expected to favour low risk corporate policies and disregard risky positive net present value projects, thus leading to acute agency problems.

Belghitar and Clark (2014) have shown that the relationship between delta and risk taking depends on whether the CEO's utility function has increasing, decreasing, or constant absolute risk aversion.[2] A negative relationship implies decreasing absolute risk aversion. Thus, for managers with decreasing absolute risk aversion delta is negatively related to investment related agency costs. Similarly for managers with increasing absolute risk aversion delta is positively related to investment related agency costs and there is no delta effect for managers with constant absolute risk aversion. Most studies either implicitly or explicitly assume decreasing absolute risk aversion, which leads to our first hypothesis.

Hypothesis 1: There is a negative relationship between delta and investment related agency costs.

2.2 Vega and agency costs

Belghitar and Clark (2014) have shown that, like delta, the effect of vega on managerial behavior depends on whether the manager has decreasing, increasing or constant absolute risk aversion. The reason for this is that vega is positive (see for

[2] Risk aversion means that each manager has a utility function $u(w)$ satisfying the following conditions: $u'(w) \geq 0, u''(w) \leq 0, \forall w$, where primes denote first and second derivatives with respect to wealth, denoted as *w*. Utility functions such as these are strictly concave. Pratt (1964) showed that maximizing the expected utility of a risk averse economic agent is approximately equal to: $A = -\frac{u''(w)}{u'(w)}$. DARA implies $\frac{dA}{dw} < 0$; IARA implies $\frac{dA}{dw} > 0$; CARA implies $\frac{dA}{dw} = 0$.

example, Hull, 2003).[3] Thus, an increase in the volatility of the firm's returns increases the manager's firm based wealth. The higher the vega, the larger is the increase in wealth. An increase in wealth affects risk aversion depending on whether the manager has decreasing, increasing or constant absolute risk aversion (see footnote 2). Thus, under the plausible assumption that managers have DARA utility functions, higher levels of vega should increase the incentive of managers to reduce agency costs. Previous studies (Guay, 1999; Knopf, et al., 2002; Coles, et al., 2006; Brockman, et al., 2010; Chava and Purnanandam, 2010; Beladi and Quijano, 2013) have found that managerial compensation sensitivity to stock return volatility does, in fact, encourage risk-taking behaviour by aligning the risk tolerance of shareholders and management. For example, Coles, et al. (2006) show that managers with higher values of vega take riskier investment decisions. In a similar vein, Beladi and Quijano (2013) find that firms pay higher loan rates as their CEOs have higher values of vega. The implication is that greater managerial incentives to engage in value maximizing risky corporate policies serve to reduce the costs of monitoring managerial behaviour. As such, a negative relationship should exist between vega and agency costs.

Hypothesis 2: There is a negative relationship between vega and investment related agency costs.

2.3 Direct cash compensation and agency costs

Unlike delta and vega, managerial direct cash compensation bears no direct sensitivity to firm performance or firm risk. In this respect Berger, et al. (1997) suggest that a higher level of managerial cash compensation is indicative of managerial

[3] Vega is the first partial derivative of the value of the option with respect to the volatility of the return on underlying asset. Because of the asymmetric payoff structure of an option, vega is always positive. In the absence of the asymmetric payoff structure, vega is equal to zero.

entrenchment. An entrenched, risk-averse manager could engage in policies that serve his interests at the expense of shareholders. Furthermore, the absence of convexity in cash compensation would not hinder the manager's pursuit of conservative corporate policies. On the other hand, Guay (1999) and Belkhir and Boubaker (2013) argue that greater direct cash compensation affords managers the opportunity to diversify their wealth outside the firm. By being more diversified, they are more inclined to engage in riskier corporate policies, which would reduce the monitoring costs of ensuring that managerial actions are congruent with shareholder interests. As such, a negative relationship between direct cash compensation and agency costs could exist.

Hypothesis 3a: There is a positive relationship between cash compensation and investment related agency costs.

Hypothesis 3b: There is a negative relationship between cash compensation and investment related agency costs.

3. Data and sample construction

The data on CEO compensation and firm based wealth incentives and characteristics was hand-collected from BoardEx, while data on firm market value equity and financial statements is from Thomson Reuters Worldscope. We exclude financial firms from the empirical analysis because the differentiation between investment and finance operations is ambiguous. The sample spans the period 2000–2004.[4] For convenience, variable definitions and sources of data are presented in Table 1.

[4] The sample period was dictated by the availability of homogenous data. The period of analysis is free of potential distortions caused by the exceptional measures taken in the wake of the worldwide financial crisis of 2007. The period of analysis is also free of potential distortions in reaction to the major tax reform of July 1997. Bell and Jenkinson (2002) report that the effects of the tax reform on equity prices continued until the end of 1999, so 2000 is the first year free of the reform's effects. 2000 is also the first year that Boardex reports estimations of CEO vega and delta. The passage of FAS 123R on December 12,

[Insert Table 1 Here]

3.1 Main variables: agency costs, executive delta, executive vega and executive salary

We follow Doukas, et al. (2005) and McKnight and Weir (2009) to capture agency costs as the interaction of firm growth opportunities and free cash flow (FCF). Based on Jensen (1986), agency costs are more pronounced among firms with low growth opportunities, relative to firms with high growth opportunities.[5] To measure a firm's growth opportunities we employ three measures; the market-to-book ratio defined as the market value of assets less the book value of assets to total assets; the q-ratio defined as the ratio of market value of equity plus total debt to total assets; and the market capitalisation ratio defined as the ratio of market capitalisation to total assets. Using these measures of growth opportunities, we create interactive variables. The interactive variable is equal to FCF multiplied by an indicator (dummy) variable that equals 1 if a firm's growth opportunity is less than the median of the sample and 0 otherwise. We define FCF as operating income before depreciation minus the sum of taxes, interest expenses and dividends paid, standardized by total assets. This measure is consistent with the measure adopted by Lehn and Poulson (1989), Doukas, et al (2005) and McKnight and Weir (2009).

The measures of executive compensation sensitivities are also consistent with prior studies (Guay, 1999; Knopf, et al., 2002; Coles, et al., 2006). CEO Delta (Vega) is

---

2004 caused Boardex to modify its database for the post-2004 period. Up to 2005 Boardex reports compensation data using the old format (pre-FAS 123R) that uses the Black-Scholes option pricer to calculate the value of stock option grants. For fiscal years 2005 and later, Boardex reports compensation using the new format (post-FAS 123R). In the post-FAS 123R period, firms calculate and expense equity-based compensation at fair value using their own valuation models. Thus, for the post-2004 data, Boardex does not calculate the Black-Scholes value of current year stock option grants, nor do they provide estimates of CEO vega and delta. Instead, Boardex reports the firm's own calculated fair values of equity-based compensation, which is not comparable across firms within the same year if firms are using different valuation methods. Additionally, for the same firm, *CEO* vega and delta are not comparable pre- and post-FAS 123R

[5] A number of studies have provided support to Jensen's arguments that agency costs occur mainly in firms with FCF and low investment opportunities (see among others Griffin et al., 2010).

defined as the pound change in the CEO's personal firm based wealth with respect to a 1% change in the stock price (stock volatility). CEO firm based wealth is measured as the value of all stock ownership, unexpired stock options and long term incentive plans (LTIPs) accumulated and held by the CEO to date [6]. Finally, CEO Cash is captured from the annual direct cash compensation paid to the CEO in the fiscal year. All compensation structures are measured in the thousands of pounds. Additional data collected from BoardEx includes the total number and the number of independent directors on the board.

3.2 Control variables

Based on prior studies on agency costs, several control variables are included in the analysis. Audit Fees is measured as the natural logarithm of total audit fees for the fiscal year (see Griffin, et al. 2010). Board size (Bsize) measured as the natural logarithm of the total directors on the board. The ratio of independent directors on the board to total members on the board (Bindep) is employed as a proxy for board independence (McKnight and Weir, 2009). The natural logarithm of total assets proxies for firm size (Fsize). We also include a measure of leverage computed as the ratio of total debts to total assets (LEV). Dividend (DIV) is defined as the ratio of total cash dividends paid to total assets. The descriptive statistics for the variables used in the current study are presented in Table 2

[6] The delta of outright share ownership is 1 and the vega is 0. The delta and vega of managerial total firm based wealth are weighted averages of the deltas and vegas of the individual shareholdings and options:

$delta = \sum_i x_i \, delta_i \quad vega = \sum_i x_i \, vega_i$, where *i* refers to the individual shareholdings and options and x_i is the proportion of asset *i* in total firm based wealth. For example, consider a manager with 50% of his wealth in shares and 50% in an option with a delta of 0.5. The delta of his portfolio will be equal to $0.5 \times 1 + 0.5 \times 0.5 = 0.75$.

[Insert Table 2 Here]

CEO Delta has a mean (median) of £94,289 (£22,000). Likewise, CEO Vega has a mean (median) of £23,060 thousand (£1,250). This finding suggests that the average (median) CEO firm based wealth increases by £94,289 (£22,000) for a 1 percent increase in the firm stock price. Similarly, the average (median) CEO firm based wealth increases by £23,060 (£1,250) for a 1 percent increase in the firm stock volatility. The sensitivities of UK CEO firm based wealth are lower than the ones reported in US studies. For example Chava et al. (2010) report an average CEO Delta (Vega) of $607,000 ($79,000). Table 2 also shows that UK CEOs receive on average (median) an annual cash compensation of £344,414 (£300,000). Table 3 presents the pairwise correlation matrix of all variables to be included in the current study. The high correlation across the different agency costs measures suggests that they serve as good proxies for each other and by extension for investment related agency costs.

[Insert Table 3 Here]

4. Empirical results

Table 4 reports the results for six specifications where the dependent variable is a measure of agency costs and the independent variables are the CEO compensation incentives and the control variables described above. As stated earlier, the agency costs are more prone to firms with free cash flow and low firm growth opportunities. To measure the agency costs, we use an interaction variable by multiplying the firm free cash flow with an indicator (dummy) variable that equals 1 if a firm's growth opportunity is less than the median of the sample and 0 otherwise. All the independent variables are lagged by one period to reduce the potential of endogeneity bias. Since the measures of agency costs distribution are left truncated at zero, we employ truncated regressions. To control for industry and time heterogeneity, we include industry and

year dummies in the regressions. Models (1), (3) and (5) in our analysis only incorporate corporate governance monitoring mechanisms and firm characteristics to provide comparisons with earlier studies. Alternatively, models (2), (4) and (6) include the compensation variables.

[Insert Table 4 Here]

The coefficient of *Audit Fees* is significantly negative across all models presented in Table 4. This finding is consistent with Griffin, et al. (2010) who argue that in low growth firms with free cash flow, managers may have an incentive to hide wasteful corporate actions through manipulation of financial statements. In this regard, Chung, et al. (2005) show that this increases audit risk and effort expended by auditors to minimize the likelihood of managerial misrepresentation of financial results and involves higher audit fees. Therefore, higher audit fees serve to reduce FCF in firms with low or poor growth opportunities, and, by extension, reduce agency costs. Similar to *Audit Fees,* a significant negative relationship between *Bsize* and agency costs is reported across models (1) and (3). This is consistent with the notion that larger boards serve to strengthen the link between corporations and their environments, provide counsel and advice regarding strategic options for the firm and play a crucial role in creating a corporate identity, whilst also serving as a monitoring mechanism, thereby making larger boards more effective in reducing agency costs (Dalton, et al., 1999). *LEV* is negatively significant only in model (2). This provides some evidence that debts serve as a potent mechanism to reduce the amount of free cash flow available to management. *Fsize* is documented as having a highly significant positive relationship with agency costs at the 1% level across all models in Table 4. This finding is consistent with larger firms being more complex and more difficult to monitor, thereby providing

managers with greater opportunities to pursue self-interest (Doukas, et al, 2005; McKnight and Weir, 2009).

Our main models (2), (4) and (6) provide significant evidence of the impact of managerial compensation incentives on agency costs. In models (2), (4) and (6) there is a significant negative relationship level between *CEO Delta* and agency costs. This finding is consistent with hypothesis 1 and the argument that the sensitivity of managerial wealth to changes in stock price (delta) serves to align the interests of managers with those of shareholders. Besides delta, models (2), (4) and (6) present evidence of a significant, negative relationship between *CEO Cash* and agency costs. This is consistent with the argument that higher levels of direct cash compensation afford the undiversified manager greater opportunity to diversify his personal wealth outside the firm (Guay, 1999). There is no evidence that sensitivity of managerial firm based wealth to stock return volatility (*CEO Vega*) has any significant effect on agency costs.[7]

4.1 Firm size, managerial compensation sensitivities and agency costs

As with other governance mechanisms, the effectiveness of managerial risk incentives may vary across firm size (Hutchinson and Gul, 2004). According to McKnight and Weir (2009) large firms tend to be complex and difficult to monitor compared to small firms. As such, managers of large firms are more prone to pursue self interest corporate policies because their actions are not easily observable. In such situations compensation based incentives could be very effective to curb self-interested managers. On the other hand, the actions of managers in small firms are easily

[7] As a robustness test we added the managerial ownership percentage to our specification, the results remain qualitatively similar to results reported in Table 4.

observable, but the agency conflict is exacerbated by the financial vulnerability of small firms due to their limited access to human and financial resources (Titman and Wessels, 1988). This suggests that larger firms are conducive to covering managerial actions and smaller firms are more financially fragile, the effect of compensation incentives may vary across the large-small environment.

To assess the impact of managerial compensation incentives on agency costs in differing organisational environments due to size, we split the sample into 3 size categories. Firms with *Fsize* less (greater) than the 40th (60th) percentile of the sample are classified as small (large) firms.[8] As in Table 4, the dependent variable is measured as the interaction between firm free cash flow and firm growth opportunity. The regression results are presented in Table 5. [9]

[Insert Table 5 Here]

In all models in Table 5 there is a significant negative relationship between *CEO Delta* and agency costs at the conventional level of significance. This is consistent with the results presented in Table 3 and suggests that irrespective of firm size, larger managerial wealth delta serves to reduce agency costs. There is also some evidence that *CEO Vega* has a negative effect on agency costs for small firms in models (2), (4) and (6) but not for large firms. The difference between smaller and larger firms could be due to more risk enhancing opportunities for smaller firms associated with their inherently higher riskiness documented by Titman and Wessels (1988). Finally, there is a highly significant, negative relationship between direct cash compensation (*CEO Cash*) and agency costs at the 1% level in large firms (models (1), (5) and (11)) but not in small

[8] We excluded firms with firm size values between the 40th and 60th percentiles because these firms cannot be easily classified as either being large or small.

[9] As a robustness test, we also consider non-interacted high FCF as the dependent variable. The results, available on request, are qualitatively similar to those for the interacted dependent variables.

firms. This effect is possibly due to the fact that salaries in the larger firms are significantly higher than those in the smaller firms, thereby providing the opportunity for managers in the larger firms to more effectively diversify their wealth portfolios.

Interestingly, the results in Table 5 suggest that monitoring mechanisms are effective tools for reducing agency costs in large firms but not in the smaller ones. In models (1) and (3) a significant negative relationship is presented between *Audit Fees* and agency costs at the 1% and 5% levels respectively. In all other models the relationship is insignificant. In model (1) *Bsize* has a significant, negative relationship with agency costs at the 5% level, while in all other regressions the coefficient of *Bsize* is insignificant. Furthermore, in model (1) there is a negative relationship between *Bindep* and agency costs at the 5% level of significance, while in all other regressions the coefficient is insignificant. *LEV* has a significant, negative relationship with agency costs at the 1% level for large firms. Overall, the evidence suggests that insofar as managerial actions are more easily observable in smaller firms, monitoring mechanisms are rendered ineffective as shareholders can directly monitor managers themselves. Compensation incentives, however, reflected in delta and vega, are more effective in reducing agency costs in the smaller firms. Both delta and vega are significant for the smaller firms and the absolute values of their coefficients are much larger than the corresponding coefficients for the larger firms.

5. Conclusion

This study establishes the first empirical link between managerial compensation and investment related agency costs. The results show that managerial compensation incentives do have a significant effect on agency costs. Delta has a significant, negative effect on agency costs for firms both large and small. However, the larger absolute values of the delta coefficients for small firms suggest that delta incentives are more

effective in reducing agency costs in the small firm environment. The significance of vega in reducing agency costs is concentrated in small firms. This finding suggests that vega exposure is more effective in the small firm environment with more risk enhancing opportunities. The significance of cash compensation in reducing agency costs is concentrated in the large firms. The implication here is that higher cash compensation reduces agency costs by affording risk-averse managers the opportunity to diversify outside the firm.

There is also some evidence that monitoring mechanisms, such as external auditors, board size and board composition, are effective in reducing agency costs in large firms but not in small ones. This suggests that if larger firms create an environment where managerial actions are less observable, monitoring mechanisms such as board of directors, external auditors and debt represent an effective means of reducing agency costs. Furthermore, the insignificance of monitoring mechanisms in reducing agency costs in small firms is evidence for the argument that managerial actions are more observable in these firms and, consequently, monitoring mechanisms are a costly and inefficient mechanism for reducing agency costs.

REFERENCES

Beladi, H., & Quijano, M. (2013) CEO incentives for risk shifting and its effect on corporate bank loan cost. *International Review of Financial Analysis, 30,* 182-188.

Belghitar, Y., & Clark, E. (2014). Convexity, magnification and translation: the effect of managerial option based compensation on corporate cash holdings. *Journal of Financial Research, 37,* 191-210.

Belkhir, M., & Boubaker S., CEO inside debt and hedging decisions: Lessons from the U.S. banking industry. *Journal of International Financial Markets, Institutions and Money, 24,* 23-246

Berger, P., Ofek, E., & Yermack, D. (1997). Managerial entrenchment and capital structure decisions. *The Journal of Finance,* 52, 1411-1438.

Brockman, P., Martin, X., & Unlu, E. (2010). Executive compensation and the maturity structure of corporate debt. *The Journal of Finance, 67,* 1123-1161.

Chava, S., & Purnanandam, A. (2010). CEOs versus CFOs: Incentives and corporate policies. *Journal of Financial Economics, 97,* 263-278.

Chung, R., Firth M., & Kim, K. (2005). Earnings management, surplus free cash flow, and external monitoring. *Journal of Business Research, 58,* 766-776.

Coles, J., Daniel, N., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics, 79,* 431-468.

Conyon, M. R., Core, J. E., & Guay, W. R. (2011). Are US CEOs paid more than UK CEOs? Inferences from Risk-Adjusted Pay. Review of Financial Studies, *24* , 402-408.

Dalton, D., Daily, C., Johnson, J., & Ellstrand, A. (1999). Number of directors and financial performance: A meta-analysis. *Academy of Management Journal, 42,* 674-86.

Doukas, J., McKnight, P., & Pantzalis, C. (2005). Security analysis, agency costs, and UK firm characteristics. *International Review of Financial Analysis, 14,* 493-507.

Fama, E. (1980). Agency problems and the theory of firm. *Journal of Political Economy, 88,* 228-307.

Goergen, M., & Renneboog, L. (2001). Strong managers and passive institutional investors in the UK, in Barca, F. and Becht, M. (eds), *The Control of Corporate Europe* (Oxford: Oxford University Press, pp. 259–284).

Griffin, P., Lont, D., & Sun, Y. (2010). Agency problems and audit fees: further tests of the free cash flow hypothesis. *Accounting & Finance, 50,* 321–350.

Guay, W. (1999). The sensitivity of CEO wealth to equity risk: an analysis of the magnitude and determinants. *Journal of Financial Economics 53,* 43-71.

Hall, B J, & Murphy, K. J. (2002). Stock options for undiversified executives, *Journal of Accounting and Economics, 33*, 3-42.

Hull, J. (2003). Options, Futures and Other Derivatives. Pearson Education, Inc., New Jersey.

Hutchinson, M., & Gul, F. (2004). Investment opportunity set, corporate governance practices and firm performance. *Journal of Corporate Finance, 10*, 595-614.

Jensen, M. (1986). Agency costs of free cash flow, corporate finance and takeovers. *American Economic Review*, 76, 323-329.

Jensen, M., & Meckling, W. (1976) .Theory of the firm: Managerial behaviour, agency costs and ownership structure. *Journal of Financial Economics, 3*, 305-360.

Knopf, J. Nam Jr., J. & Thorton, J. (2002). The volatility and price sensitivities of managerial stock option portfolios and corporate hedging. *The Journal of Finance 57*, 801-814.

Lehn, K., & Poulsen, A. (1989). Free cash flow and stock holder gains in going private transactions. *The Journal of Finance, 44*, 771– 789.

McKnight, P., & Weir, C. (2009). Agency costs, corporate governance mechanisms and ownership structure in large UK publicly quoted companies: A panel data analysis. *Quarterly Review of Economics and Finance, 49*, 139-158.

Murphy, K. (1999). Executive compensation. In: Ashenfelter, O., Card, D. (Eds.), Handbook of LaborEconomics, vol. 3b (Chapter 38). Elsevier Science, North Holland, 2485–2563.

Pratt, J. (1964). Risk aversion in the large and in the small. *Econometrica, 32*, 122-136.

Richardson, S. (2006). Over-investment of free cash flow. *Review of Accounting Studies 11*, 159–189.

Stulz, R. & Smith, C. (1985). The determinants of firms' hedging policies. *Journal of Financial and Quantitative Analysis, 28*, 397-405.

Titman, S. & Wessels, R. (1988). The determinants of capital structure choice. *The Journal of Finance*, 43, 1-19.

Table 1: Variable empirical definition and data sources

Variables	***Empirical definition***	***Source***
CEO Delta	CEO Delta is the pound change in CEO firm based wealth* for a 1% change in stock price, in thousands. * CEO firm based wealth includes all equity holdings (share ownership), unexpired stock and LTIPs options accumulated and held by the CEO to date (£, thousands).	Boardex
CEO Vega	CEO Vega is the pound change in the CEO's firm based wealth* for a 1% change in stock return standard deviation, in thousands.	Boardex
CEO Cash	The sum of all cash based compensation received by the CEO during the year (salary, bonus, pension, and other).	Boardex
FCF	Operating income before depreciation minus the sum of taxes, interest expenses and dividends paid, standardized by total assets.	Worldscope
MKTBV	The ratio of book value of total assets minus the book value of equity plus the market value of equity to the book value of total assets	Worldscope
Q_Ratio	The ratio of market capitalisation plus total debt divided by total assets.	Worldscope
MCAP	The ratio of market capitalisation to total assets	Worldscope
Audit fees	The natural logarithm of audit fees for the fiscal year	Worldscope
Bsize	The natural logarithm of total directors on the board. Bindep is the ratio of total independent directors on the board to total directors on the board	Boardex
Bindep	Bindep is the ratio of total independent directors on the board to total directors on the board	Boardex
LEV	The ratio of long-term total debt to total assets.	Worldscope
Fsize	The natural logarithm of total assets	Worldscope
DIV	The ratio of total cash dividends paid to total assets	Worldscope

Table 2: Descriptive Statistics

Variable	N	Mean	SD	Median	Min	Max
FCF	1942	0.055	0.127	0.069	0.004	0.401
MKTBV	1894	2.071	2.612	1.447	0.421	41.053
Q_Ratio	1942	1.683	2.585	1.081	0	40.840
MCAP	1894	1.493	2.637	0.873	0	42.650
CEO Delta	1541	94.289	400.952	22	0	12881
CEO Vega	1397	23.063	160.242	1.253	0	2481.039
CEO Cah	1504	344.414	200.650	300	5.423	1678.396
Audit Fees	1823	6.378	1.455	6.217	1.792	14.293
Bsize	1851	2.084	0.311	2.079	0.693	3.091
Bindep	1851	0.437	0.159	0.429	0	0.875
LEV	1851	0.331	0.327	0.217	0	1
Fsize	1851	12.897	1.827	12.736	5.971	18.961
DIV	1851	0.026	0.032	0.020	0	0.693

FCF is measured as the operating income before depreciation minus the sum of taxes, interest expenses and dividends paid, standardized by total assets. MKTB is the ratio of book value of total assets minus the book value of equity plus the market value of equity to the book value of total assets. QRATIO is the ratio of market capitalisation plus total debt divided by total assets. MCAP is the ratio of market capitalisation to total assets. CEO Delta is the pound change in CEO firm based wealth for a 1% change in stock price, in thousands. CEO Vega is the pound change in the CEO's option based wealth for a 1% change in stock return standard deviation, in thousands. CEO_Cash is measured as the sum of all cash based compensation received by the CEO during the year. Audit Fees is the natural logarithm of audit fees for the fiscal year. Bsize is the natural logarithm of total directors on the board. Bindep is the ratio of total independent directors on the board to total directors on the board. LEV is the ratio of short-term debt total debt. Fsize is the natural logarithm of total assets. DIV is the ratio of total cash dividends paid to total assets. All variables have been winsorized at the 1st and 99th percentile.

Table 3. Correlation Matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1.FCF_MKTBV	1											
2.FCF_QRATIO	**0.901**	1										
3.FCF_MCP	**0.856**	**0.881**	1									
4.CEO Delta	-0.118	-0.107	-0.118	1								
5.CEO Vega	**-0.085**	**-0.076**	**-0.077**	**0.274**	1							
6.CEO Cash	-0.024	-0.015	0.016	**0.201**	**0.379**	1						
7.Audit Fees	**0.118**	0.120	**0.153**	0.081	0.246	**0.679**	1					
8.Bsize	0.037	**0.040**	**0.070**	0.114	**0.211**	**0.566**	**0.569**	1				
9.Bindep	0.003	0.006	0.031	0.038	**0.102**	**0.294**	**0.304**	**0.072**	1			
10.LEV	**-0.107**	-0.077	**-0.122**	0.042	**-0.025**	**-0.086**	**-0.104**	**-0.092**	**-0.103**	1		
11.Fsize	**0.212**	**0.202**	**0.243**	0.118	0.248	**0.762**	**0.812**	**0.672**	**0.267**	**-0.157**	1	
12.DIV	**0.083**	**0.082**	**-0.039**	0.094	0.104	**0.131**	**0.089**	**0.048**	**0.086**	**0.059**	**0.077**	1**.**

Values in bold are significant at the 5 % level and above. FCF_MKTB is measured as the interaction variable between free cash flow to total assets and market-to-book-ratio. FCF_QRATIO is measured as the interaction variable between free cash flow to total assets and Q-ratio. FCF_MCAP is measured as interaction variable between free cash flow to total assets and market capitalization ratio. CEO Delta is the pound change in CEO firm based wealth for a 1% change in stock price, in thousands. CEO Vega is the pound change in the CEO's option based wealth for a 1% change in stock return standard deviation, in thousands. CEO_Cash is measured as the sum of all cash based compensation received by the CEO during the year. Audit Fees is the natural logarithm of audit fees for the fiscal year. Bsize is the natural logarithm of total directors on the board. Bindep is the ratio of total independent directors on the board to total directors on the board. LEV is the ratio of short-term debt total debt. Fsize is the natural logarithm of total assets. DIV is the ratio of total cash dividends paid to total assets.

Table 4: Agency Costs regressed against executive compensation sensitivities, corporate governance mechanisms and firm characteristics.

	FCF_MKTB		FCF_QRATIO		FCF_MCAP	
	(1)	(2)	(3)	(4)	(5)	(6)
CEO Delta		-0.064*		-0.063*		-0.064*
		(0.080)		(0.079)		(0.076)
CEO Vega		0.046		-0.001		0.021
		(0.741)		(0.993)		(0.879)
Log (CEO Cash)		-0.057**		-0.440**		-0.031*
		(0.001)		(0.007)		(0.062)
Audit Fees	-0.007**	-0.005**	-0.010**	-0.010**	-0.012**	-0.010**
	(0.000)	(0.016)	(0.002)	(0.019)	(0.001)	(0.017)
Bsize	-0.016**	-0.013	-0.016**	-0.008	-0.013	-0.017
	(0.028)	(0.216)	(0.027)	(0.440)	(0.112)	(0.116)
Bindep	0.007	-0.002	0.018*	0.021	0.004	0.009
	(0.466)	(0.870)	(0.083)	(0.176)	(0.714)	(0.570)
LEV	-0.007	-0.013**	-0.003	-0.003	0.002	-0.007
	(0.128)	(0.018)	(0.490)	(0.632)	(0.772)	(0.298)
Fsize	0.008**	0.014**	0.012**	0.017**	0.013**	0.015**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)
DIV	-0.106**	-0.044	-0.086*	-0.030	0.019	0.007
	(0.019)	(0.322)	(0.052)	(0.517)	(0.677)	(0.875)
Constant	-0.030*	-0.083**	-0.060**	-0.122**	-0.051	-0.065*
	(0.077)	(0.002)	(0.012)	(0.001)	(0.112)	(0.058)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Ind. dummies	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	1389	986	1389	986	1389	986
R^2	12.31%	19.95%	10.21%	16.67%	12.31%	17.22%

Agency costs are the dependent variables, and they are measured at time t. All independent variables are measured at time t-1. FCF_MKTB is dependent variable in models (1) and (2) and is measured as the interaction variable between the free cash flow to total assets and market-to-book-ratio. FCF_QRATIO is the dependent variable for models (3) and (4) and is measured as the interaction variable between the free cash flow to total assets and Q-ratio. FCF_MCAP is the dependent variable in models (5) and (6) and is measured as interaction variable between the free cash flow to total assets and market capitalization ratio. For empirical definition of the independent variables see Table 1. 4-digit industry classifications are included in the regression The models are estimated with the tobit estimator and p-values are in parentheses and are robust to heteroscedasticity. * $p < 0.10$, ** $p < 0.05$.

Table 5: Agency Costs regressed against executive compensation sensitivities, corporate governance mechanisms and firm characteristics based on firm size.

	FCF_MKTBV		$\chi^2_{(1)}$	FCF_QRATIO		$\chi^2_{(1)}$	FCF_MCAP		$\chi^2_{(1)}$
	L. Firms	S. Firms		L. Firms	S. Firms		L. Firms	S. Firms	
	(1)	(2)		(3)	(4)		(5)	(6)	
CEO Delta	-0.040**	-0.200*	4.99***	-0.040**	-0.200*	4.31**	-0.040**	-0.200*	5.14***
	(0.014)	(0.078)		(0.029)	(0.080)		(0.028)	(0.067)	
CEO Vega	-0.031	-0.502*	2.95*	0.130	-0.510*	2.07	0.094	-0.567**	3.11*
	(0.830)	(0.088)		(0.365)	(0.090)		(0.955)	(0.042)	
Log(CEO Cash)	-0.012***	-0.090	6.20***	-0.010***	-0.041	4.01**	-0.010***	-0.0521	5.34***
	(0.001)	(0.270)		(0.001)	(0.625)		(0.001)	(0.641)	
Audit Fees	-0.009***	0.006		-0.007**	-0.002		-0.004	-0.018	
	(0.003)	(0.935)		(0.019)	(0.767)		(0.224)	(0.210)	
Bsize	-0.035**	-0.028		-0.009	-0.033		-0.024	-0.015	
	(0.028)	(0.267)		(0.574)	(0.190)		(0.171)	(0.557)	
Bindep	-0.064**	0.022		-0.041	0.039		-0.027	0.054	
	(0.019)	(0.517)		(0.134)	(0.245)		(0.370)	(0.105)	
LEV	-0.057***	-0.006		-0.036***	0.001		-0.045***	0.009	
	(0.000)	(0.623)		(0.003)	(0.902)		(0.000)	(0.535)	
Fsize	0.0243***	0.026***		0.014***	0.025***		0.018***	0.041***	
	(0.000)	(0.001)		(0.001)	(0.001)		(0.000)	(0.001)	
DIV	-0.201**	0.033		-0.223*	0.054		-0.135	0.036	
	(0.046)	(0.681)		(0.053)	(0.515)		(0.153)	(0.647)	
Constant	0.063**	0.008		0.026	-0.121**		-0.220**	-0.113	
	(0.028)	(0.775)		(0.459)	(0.020)		(0.009)	(0.171)	
Year dummies	Yes	Yes		Yes	Yes		Yes	Yes	
Ind. dummies	Yes	Yes		Yes	Yes		Yes	Yes	
Obs.	475	307		475	307		475	307	
R^2	26.37%	23.79%		18.91%	22.04%		17.57%	21.07%	

Agency costs are the dependent variable, and they are measured at time t. All independent variables are measured at time t-1. FCF_MKTB is dependent variable in models (1) and (2) and is measured as the interaction variable between the free cash flow to total assets and market-to-book-ratio. FCF_QRATIO is the dependent variable for models (3) and (4) and is measured as the interaction variable between the free cash flow to total assets and Q-ratio. FCF_MCAP is the dependent variable in models (5) and (6) and is measured as interaction variable between the free cash flow to total assets and market capitalization ratio. For empirical definition of the independent variables see Table 1 Models (1), (3), (5) are regressions on a subsample of large firms, while models (2), (4) and (6) are regressions on a subsample of small firms. 4-digit industry classifications are included in the regression. $\chi^2_{(1)}$ is the test of difference between the coefficient of large sample and small sample. The results are based on Tobit estimator. P-values are presented in parenthesis and are robust to heteroscedasticity. ***, ** and * represent 1%, 5% and 10% levels of significance respectively.