The Role of Stock Liquidity in Executive Compensation

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Abstract

We explore the role of stock liquidity in influencing the composition of CEO annual pay and the sensitivity of managerial wealth to stock prices. We find that as stock liquidity goes up, the proportion of equity-based compensation in total compensation increases while the proportion of cash-based compensation declines. Further, the CEO's pay-for-performance sensitivity with respect to stock prices is increasing in the liquidity of the stock. Our main findings are supported by additional tests based on shocks to stock liquidity and two-stage-least squares specifications that mitigate endogeneity concerns. Our results are consistent with optimal contracting theories and contribute to the ongoing debate about the increasing trend of both equity-based over cash-based compensation and the sensitivity of total CEO wealth to stock prices rather than earnings.

Keywords: Stock liquidity, executive compensation, optimal contracting

Data availability: Data used for this study are derived from publicly available sources.

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> "…over the last three decades, the total sensitivity of executive wealth to changes in shareholder wealth has become dominated by executives' stock and stock option portfolios, as opposed to cash compensation or other components of executives' pay packages…In addition, cash compensation itself appears to have become a less important component of the overall pay–performance sensitivities of top executives".
>
> Bushman and Smith (2001, 242)

I. INTRODUCTION

As the above quote indicates, the importance of stock prices as opposed to that of accounting numbers in executive pay contracts has been increasing dramatically. These changes can be seen in both the composition of pay (salary & bonus payouts versus stock grants) and in the sensitivity of total pay to both accounting earnings and stock returns. Specifically, in empirical tests that regress CEO pay on both stock returns and earnings, Bushman et al. (1998) find that the coefficient on accounting earnings has been relatively constant over time, but that on stock returns has been consistently increasing. The culprit behind this shift in composition and sensitivity is readily identifiable: over this time period, firms dramatically increased their grants of both stock options and restricted stock. And while these changes in compensation policies were likely in response to calls to increase shareholder value, Bushman and Smith (2001) emphasize that the reasons underlying these changes are still not very well understood.

In this paper, we rely on theories of market microstructure and propose stock liquidity as one possible contributor to both features of compensation contracts – (i) the declining importance of cash-based compensation in annual CEO pay packages and (ii) the greater reliance on stock prices over earnings in pay-for-performance sensitivity (PPS). Empirically, we find that greater stock liquidity is associated with a lower proportion of cash-based pay and with higher PPS with respect to stock prices. These results hold both cross-sectionally and over

time, and our interpretation is that increases in stock liquidity affect compensation contracts in two ways. First, because executives value liquidity, greater stock liquidity increases their preference for stock-based compensation relative to cash-based compensation. Second, as stock liquidity increases, the reduced trading costs encourage informed traders to impound more information about the manager's actions in the stock price (see Chordia et al. 2008). These increases in stock price informativeness result in greater reliance being placed on stock prices in PPS relative to other performance metrics such as earnings (see Holmstrom and Tirole 1993; Fang et al. 2009).

The above arguments assume a positive association between the valuation and contracting roles of stock prices. That is, when stock prices are more informative to investors in the market, they are also assumed to be more informative about the manager's actions and thus more useful for contracting purposes. While some theorists (e.g., Gjesdal 1981; Paul 1992; Lambert 1993) have suggested that these alternative uses of information need not coincide, recent studies such as Bushman et al. (2006) show analytically that performance measures that incorporate multi-period effects of the manager's actions (not fully captured by current period earnings) perform both a valuation as well as a contracting role. Stock liquidity, in our setting, performs such a dual role. In this sense, our study adds to the findings of Banker et al. (2009) and Bushman et al. who find a positive association between the contracting and valuation roles of performance measures.

Our arguments rest on the premise that differences in stock liquidity determine the extent of stock price informativeness, and not the other way around. This link is motivated by Grossman and Stiglitz (1980), Kyle (1985), Holmstrom and Tirole (1993) and Easley and O'Hara (2004), who model informed traders who optimally choose their trading intensity as a function of stock liquidity, thereby determining the amount of private information that is impounded in

the stock price. The more liquid the stock, the more intense the trading, which thereby increases the informativeness of the stock price. Most relevant evidence on this is given by Chordia et al. (2008) who find that greater liquidity stimulates arbitrage activity, which, in turn, enhances market efficiency by incorporating more private information into prices. Chordia et al. explicitly test for reverse causality and find that the *p*-value for the null that liquidity Granger-causes informativeness is 0.001, whereas that for the reverse hypothesis that informativeness causes liquidity is 0.141.

Turning first to our cross-sectional results, we find that the proportion of cash-based pay as part of total annual compensation is lower in firms with greater stock liquidity. In terms of economic significance, a one standard deviation increase in stock liquidity reduces the proportion of cash-based pay in total compensation by 7% relative to the mean. Second, we find that PPS of total CEO wealth with respect to stock prices is greater in firms with higher stock liquidity. PPS increases by 4% (relative to the mean) for every standard deviation increase in stock liquidity. We do not find any evidence of stock liquidity affecting *PPS* with respect to either earnings or cash flows.[1]

Next, we perform three additional tests to shed further light on the issue of causality of stock liquidity on executive compensation. First, we implement a two-stage least squares estimation to explicitly address the endogeneity of stock liquidity. We rely on the framework of Fang et al. (2009) and use both the lagged value of each firm's stock liquidity and the stock liquidity of the median firm in the industry as exogenous variables. We find that the predicted value of stock liquidity is strongly and negatively related to cash-based compensation in this

[1] The insignificant weights on earnings and cash flows also help rule out the possibility that our results might be driven by investor myopia. If firms with greater stock liquidity are held by investors with shorter trading horizons, then one could argue that the greater weight on stock prices might be reflecting investor myopia. However, in this case, one should also expect a commensurate greater weight on earnings, which is not present in our data.

two-stage least squares framework. Further, the relation between predicted stock liquidity and PPS with respect to stock prices is also robust in this framework.

Our second supporting test uses stock-splits as an event that results in increases in stock liquidity without any associated change in firms' underlying fundamentals (e.g., Maloney and Mulherin 1992; Easley et al. 2001). By examining changes in cash-based compensation and PPS around stock-splits, we essentially treat every firm as its own control, thereby mitigating any omitted variable bias. We find strong evidence that stock-splits are associated with a significant decrease in the proportion of cash-based compensation to total compensation and a strong increase in PPS with respect to stock prices.

Third, we provide inter-temporal evidence of the link between stock liquidity, cash-based compensation and PPS using regressions that involve firm-specific changes. In this approach, we regress changes in cash-based compensation (and changes in PPS) on changes in both stock liquidity and in the other control variables. Consistent with Bushman and Smith (2001), we find that the proportion of cash-based pay relative to total compensation is steadily declining during our sample period. Further, PPS with respect to stock prices is also increasing during this period. Consistent with our story, we find that average stock liquidity of our sample firms is continuously increasing over this same period. We find strong evidence of this intertemporal relation at the firm level in that changes in cash-based compensation (changes in PPS with respect to stock prices) are negatively (positively) associated with changes in stock liquidity over annual, three-year, and five-year intervals.

To further buttress our results, we perform a battery of robustness tests. First, we examine changes in CEO cash compensation (following Lambert and Larcker 1987 and Sloan 1993) rather than changes in total CEO wealth to measure pay-for-performance sensitivity (see Core et al. 2003). Consistent with these studies, the weight on earnings is, on average, higher

than that on stock prices in these regressions. However, as stock liquidity goes up, the reliance on stock prices increases whereas the reliance on earnings decreases. Our evidence suggests that higher stock liquidity partially mitigates some of the negative aspects of stock prices vis-à-vis earnings as a performance measure by incorporating more information about the manager's actions into the stock price.

While we use the Core and Guay (1999; 2002) measure of delta to measure PPS with respect to stock prices, our results are robust to alternate measures of estimating PPS viz., the Jensen and Murphy (1990) statistic and also the scaled measure of PPS suggested by Edmans et al. (2009). Further our inferences are unaffected by the use of alternate measures of stock liquidity, including the relative bid-ask spread, the Amihud (2002) measure of illiquidity and the Lesmond et al. (1999) measure of percentage of zero returns. We also follow the methodology of Hayes and Schaefer (2000) to verify that our results are robust to incorporating the effect of other unobservable performance measures that might be used. Again, our interpretation remains intact.

As a final test, we use the firm's addition to the S&P 500 Index to further examine the role of stock liquidity on executive compensation. The role of stock liquidity in the mix of annual CEO pay follows from executives' preference for greater liquidity while its role in PPS stems from the greater informativeness of the stock price. A firm's addition to the S&P 500 Index provides an interesting experiment in that it *increases* stock liquidity (e.g., Shleifer 1986; Beneish and Whaley 1996) but *reduces* stock price informativeness (e.g., Vijh 1994; Barberis et al. 2005). Thus, we expect Index additions to be associated with decreases in the proportion of cash-based compensation to total compensation and yet decreases in PPS.

We find some evidence in favor of those predictions. While Index additions are associated with decreases in cash-compensation and decreases in PPS with respect to stock

prices, the statistical significance of these findings is weak. We believe that this finding sharpens the earlier results of Garvey and Swan (2002) and Kang and Liu (2006) who identify a strictly positive relationship between stock price informativeness and PPS. Our interpretation is that the empirical relationship is richer than previously modeled and consistent with the theoretical work of Calcagno and Heider (2007) who argue that increases in stock liquidity can at times result in decreases in stock price informativeness when informed traders have short trading horizons. Consistent with this notion, Barberis et al. (2005) find that S&P 500 Index addition results in greater following by index funds who actually have shorter trading horizons and trade predominantly for non-informational reasons.

Overall, our study relies on an optimal contracting framework to provide evidence that higher stock liquidity is an important contributor to two important trends in executive compensation -- the declining importance of cash relative to total compensation in annual CEO pay packages and the higher reliance on stock prices in determining PPS. In addition to using cross-sectional measures of stock liquidity that are common in the market microstructure literature, we also rely on stock-splits and firm additions to the S&P 500 Index as experiments to examine how shocks to stock liquidity affect features of executive compensation. We consistently find that increases in stock liquidity affect executive compensation in two ways – (i) because agents value liquidity, greater stock liquidity shifts the mix of annual compensation in favor of stock-based compensation; and (ii) as stock liquidity facilitates more informative stock prices about the manager's actions, it is associated with greater reliance on stock prices in PPS.

The rest of the paper is arranged as follows. Section II further outlines our theoretical motivation and delineates our empirically-testable hypotheses. Section III presents the research design, while Section IV contains our results. Section V tackles issues of causality and details our robustness tests. Concluding remarks are offered in Section VI.

II. MOTIVATION AND TESTABLE HYPOTHESES

Agency-theoretic models predict that stock liquidity will affect features of executive compensation in two ways. The first pertains to how stock liquidity affects the mix of annual compensation flows in terms of cash versus stock; and the second pertains to how it affects the reliance on stock prices in pay-for-performance sensitivity.

Garvey (1997) models the role of stock liquidity in executive compensation and shows that greater stock liquidity reduces the manager's cost of selling her equity holdings. Because risk-averse agents prefer higher liquidity, greater stock liquidity increases the manager's preference for stock-based compensation relative to cash-based compensation. As the optimal contract moves away from cash-based to stock-based compensation when liquidity is higher, we expect greater stock liquidity to be associated with less cash-based compensation in the data.

Next, we explore the role of stock liquidity in the use of stock prices in managerial pay-for-performance sensitivity (PPS). In classical theories of optimal contracting in hidden action environments (e.g., Holmstrom 1979; Banker and Datar 1989), the equilibrium weight placed on the manager's output depends directly on its "signal-to-noise" ratio. The general idea is that an increase in noise reduces the effectiveness of output as a performance measure for incentive purposes, whereas an increase in the responsiveness of the signal to the manager's action represents a more informative and effective output measure. Prior studies find that stock liquidity results in more information about the manager's actions being impounded in the stock price and thus an increase in the latter's contracting role.

Holmstrom and Tirole (1993) show how greater stock liquidity due to uninformed traders introduces randomness into stock prices, which consequently draws in more informed traders to trade on their private information. In their equilibrium, when stock liquidity is higher, the increased informed trading dominates the increased uninformed trading and thus

results in greater average stock price informativeness.[2] In empirical support of this claim, Chordia et al. (2008) provide evidence that firms with greater stock liquidity are, in fact, associated with more informative prices. With this increased stock price informativeness, Holmstrom and Tirole argue that the firm can offer steeper stock-based incentives to senior management. Fang et al. (2009) make a similar conjecture by claiming that their finding of increased stock liquidity leading to better firm performance is due to the effect of stock liquidity on managerial incentives. Thus, we expect firms with higher stock liquidity to rely more on stock prices in managerial pay-for-performance sensitivity.

The arguments above suggest that firms with greater stock liquidity should rely less on cash-based relative to equity-based compensation (Garvey 1997) and place greater emphasis on stock prices relative to earnings and cash flows in providing performance incentives (Holmstrom and Tirole 1993). There are, however, some countervailing theoretical arguments to these statements in the literature. We describe two here. The first suggests that higher stock liquidity can actually be associated with less informative prices, which thereby calls for lower PPS. The second argument attempts to distinguish between the valuation and contracting roles of stock prices.

Calcagno and Heider (2007) show that having either multiple informed traders or shorter informed trading horizons can result in equilibria where greater stock liquidity reduces stock price informativeness. In these situations, stock price informativeness decreases because the increase in uninformed trading is greater than the increase in informed trading, thereby

[2] In a simple Kyle (1985) framework extended to multiple informed traders, increases in uninformed trading are exactly offset by more aggressive trading from the informed. The end result is that stock price informativeness remains unchanged. However, such a result disappears as long as there are costs to becoming informed.

reducing the value of stock prices in PPS.[3] In an alternative setup, Ferreira et al. (2008) model private benefits as being negatively related to stock price informativeness and find that greater stock price informativeness results in lower pay-for-performance sensitivity. Here an informative stock price mitigates agency conflicts resulting from moral hazard and thus reduces the need to align the agent's interest through equity compensation. Thus, these models suggest that we should expect firms with greater stock liquidity to rely less on stock prices in setting PPS.

The second argument focuses on the potential misalignment of information related to valuation and contracting purposes. For example, if the higher stock price informativeness in more liquid firms pertains to factors outside the manager's control (such as competitors' actions or customer preferences), then stock price might not necessarily be used more heavily in its PPS contracting role. Gjesdal (1981) originally makes this point by illustrating that the ranking of information systems for valuation purposes need not coincide with the ranking of information systems for control purposes. Paul (1992) shows that when informed traders do not collect information directly related to the manager's effort, greater informed trading need not increase the usefulness of stock prices for managerial incentives. Lambert (1993) similarly remarks that the task of valuing firms is not necessarily the same as evaluating a manager's contribution to firm value.

Recent work has shed more light on the relation between the valuation and the contracting roles of earnings. Bushman et al. (2006) show analytically that performance measures that incorporate multi-period effects of the manager's actions which are not fully captured by current period earnings perform a valuation and a contracting role. Empirically,

[3] See De Long et al. (1990) for a general model of how informed traders' short horizons generate 'noise trader risk' in financial markets.

Banker et al. (2009) and Bushman et al. both find a positive association between the contracting and valuation roles of earnings and cash flows.

While the above theoretical arguments suggest that stock liquidity could have an ambiguous effect on stock price informativeness, we make predictions based on the overall weight of the empirical evidence. Our hypotheses relating to the compensation mix and the importance of stock prices in estimates of PPS are as follows:

H1: Firms with greater stock liquidity have a lower proportion of cash-based compensation to total compensation.

H2: Firms with greater stock liquidity rely more on stock prices in determining pay-for-performance sensitivity.

III. RESEARCH DESIGN

We begin by describing our variables, and then our data sources, and finally delineate our empirical specifications.

Variables

Stock Liquidity (Liq)

Our main measure of stock liquidity (*Liq*) is turnover, defined as the log of the ratio of total shares traded annually divided by shares outstanding.[4] We rely on turnover for two reasons. At a theoretical level, Lo and Wang (2000) develop the volume implications of popular asset-market equilibrium pricing models and conclude that stock turnover is the most natural measure and that it yields the sharpest empirical implications. From an empirical standpoint,

[4] Our results are robust to using alternate measures, such as the bid-ask spread, the Amihud (2002) measure of illiquidity and the percentage of zero-returns used by Lesmond et al. (1999). We present these robustness tests in Section 5.

because turnover involves scaling shares traded by shares outstanding, it implicitly controls for firm size and enables comparison across firms and over time.[5]

Cash Compensation (Cashcomp)

We define cash compensation (*Cashcomp*) as the proportion of cash-based compensation (the sum of Execucomp data items "salary" and "bonus") to total annual compensation (data item "tdc1").

Pay-for-performance Sensitivity with respect to Stock Prices (Delta)

Following prior studies such as Chava and Purnanandam (2010), Jayaraman and Milbourn (2011) and Jiang et al. (2010), we measure pay-for-performance sensitivity (PPS) with respect to stock prices using the Core and Guay (1999; 2002a) measure of delta (*Delta*).[6] *Delta* captures the dollar change in the value of the manager's stock and options holdings from a one percentage point increase in the company's stock price. We construct this delta measure based on Core and Guay's methodology. In particular, we divide the manager's options into three groups: those awarded in the current year, those awarded in previous years but not yet exercisable, and those that are currently exercisable. For each group, we obtain or construct measures of the exercise price and other variables in the Black-Scholes option formula from the ExecuComp dataset.

[5] This is especially relevant in the compensation literature because prior studies highlight the possibility of incorrect inferences in the absence of appropriate controls for firm size (see Aggarwal and Samwick 2002; Core and Guay 2002b).

[6] Our results are robust to using the Jensen and Murphy (1990) measure and also to using scaled measures of delta (Edmans et al. 2009), as discussed in robustness tests in Section 5.

Control Variables

Because prior studies find that the investment opportunity set affects stock-based incentives (e.g., Smith and Watts 1992), we define *Tobin's Q* as the ratio of market value to book value of assets and include it to capture the investment opportunity set. We use both accounting and stock price based measures to capture performance. *ROA* is defined as income before extraordinary items scaled by total assets and cash flow from operations scaled by total assets (*CFO*) captures accounting performance while the annual *Stock return* captures market performance. [7]

We also include *ROA volatility*, cash flow volatility (*CFO volatility*) and *Stock return volatility* to capture the volatility of the operating environment. *ROA volatility*, *CFO volatility* and *Stock return volatility* are computed as standard deviations of five annual observations of *ROA*, *CFO* and *Stock return*, respectively. Prendergast (2000; 2002) argues that firms rely more on stock-based incentives in riskier environments where it is more difficult to monitor the manager's actions. On the other hand, studies such as Demsetz and Lehn (1985), Lambert and Larcker (1987), Aggarwal and Samwick (1999) and Garvey and Milbourn (2003) argue that greater volatility captures more noise in the output measure and firms should therefore reduce stock-based incentives (see Dai et al. 2009 for an event-study approach to shed light on this question). We do not make a directional prediction for these volatility measures. We control for firm size using the log of total sales (*LogSales*), and we include year and industry fixed effects defined at the 2-digit SIC code level. Following Petersen (2009), we cluster the robust standard errors by executive. We winsorize all variables at the one percent tails to reduce the influence of outliers.

[7] Our results are robust to excluding cash flows and including only earnings.

Empirical Specifications

To address how the composition of pay and the sensitivity of managerial wealth to stock prices relate to stock liquidity, we use the following empirical specifications.

Relation between Cash-based Compensation (Cashcomp) and Stock Liquidity (Liq)

We use three empirical specifications to test the relation between *Cashcomp* and *Liq*. We first present a median regression as follows:

$$\begin{aligned} Cashcomp = {} & \alpha_0 + \alpha_1 Liq + \alpha_2 Tobin's\ Q + \alpha_3 ROA + \alpha_4 CFO + \alpha_5 Stock\ return \\ & + \alpha_6 ROA\ volatility + \alpha_7 CFO\ volatility + \alpha_8 Stock\ return\ volatility \\ & + \alpha_9 LogSales + \sum Year + \sum Industry + \varepsilon \end{aligned} \quad (1)$$

Hypothesis *H1* predicts that the coefficient on α_1 will be positive. We follow this specification with an OLS regression and another that also includes executive fixed effects. The latter specification is especially useful in controlling for correlated omitted CEO characteristics that could affect both *Cashcomp* and *Liq*.

Relation between PPS and Stock Prices (Delta) and Stock Liquidity (Liq)

Similar to *Cashcomp*, we estimate the relation between the log of *Delta* (*LnDelta*) and stock liquidity using the following specification:

$$\begin{aligned} LnDelta = {} & \beta_0 + \beta_1 Liq + \beta_2 Tobin's\ Q + \beta_3 ROA + \beta_4 CFO + \beta_5 Stock\ return \\ & + \beta_6 ROA\ volatility + \beta_7 CFO\ volatility + \beta_8 Stock\ return\ volatility \\ & + \beta_9 LogSales + \sum Year + \sum Industry + \varepsilon \end{aligned} \quad (2)$$

Hypothesis *H2* predicts that the coefficient on β_1 will be positive.

Data and Descriptive Statistics

Our data come from three sources. Stock liquidity data are from CRSP, earnings and sales data come from Compustat, and compensation data are from ExecuComp. Our sample period is from 1992 to 2007. It uses 2,855 large U.S. firms resulting in 21,750 firm-year observations with non-missing data for all variables.

<INSERT TABLE 1 ABOUT HERE>

Panel A of Table 1 summarizes the variables of interest, which are all consistent with other studies that rely on ExecuComp. The average CEO receives an annual salary and bonus of around $625,000 and $592,000, respectively. The average and median proportions of cash-based compensation to total compensation (*Cashcomp*) are 50% and 46%, respectively. The average (median) *Delta* of 714.547 (149.16) indicates that the average (median) CEO's wealth increases by $714,547 ($149,160) for a 1% increase in the stock price. These data are similar to those reported by recent studies such as Chava and Purnanandam (2010) and Jayaraman and Milbourn (2011). *Tobin's Q* ranges from a minimum of 0.796 to a maximum of 8.383, with an average value of around 2. The average annual *ROA*, CFO and *Stock return* are 5.2%, 10.8% and 15.5%, respectively. Annual *Sales* for the median firm is $1.16 billion.

Panel B presents Spearman correlations between the variables, which again reveal few surprises. *Cashcomp* and *Liq* are negatively related (-0.33), suggesting that more liquid firms are associated with lower cash compensation. Further, the correlation between *Liq* and the log of delta (*LnDelta*) is positive (0.29) and highly significant, indicating that higher PPS with respect to stock prices is associated with greater stock liquidity.

IV. EMPIRICAL RESULTS

Univariate Evidence

<INSERT FIGURE 1 ABOUT HERE>

Figure 1 presents the univariate relations between cash-based compensation and stock liquidity, and between delta and stock liquidity. The x-axis plots decile ranks of stock liquidity and the y-axis plots median values of *Cashcomp* (Panel A) and *Delta* (Panel B) that correspond to these deciles. The downward sloping curve in Panel A indicates that higher stock liquidity is associated with a smaller proportion of cash pay, consistent with hypothesis *H1*. Specifically, we find that *Cashcomp* for firms in the least liquid decile is 71%, as compared to 27% for firms in the highest decile of stock liquidity.

The upward sloping curve in Panel B indicates that firms with higher stock liquidity are associated with higher *PPS* with respect to stock prices. A 1% increase in the stock price increases managerial wealth by $48,000 for firms in the lowest decile of stock liquidity. On the other hand, a comparable change for firms in the highest liquidity decile is around $316,000. These results are consistent with hypothesis *H2*, and suggest that firms rely more on stock prices in designing executive compensation when stock liquidity is high.

Multivariate Evidence

<INSERT TABLE 2 ABOUT HERE>

Turning to our multivariate tests, Table 2 presents results of the regressions of *Cashcomp* and *LnDelta* on *Liq* and controls. The first three specifications present results for *Cashcomp*, while the next three columns pertain to *LnDelta*. The first specification within each set of results presents the median regression, the second the OLS regression and the third the OLS regression with executive fixed effects. Confirming the evidence from the univariate tests, the coefficient

on *Liq* is negative and significant at less than the 1% level in all three *Cashcomp* specifications, suggesting that the proportion of cash-based compensation to total compensation is lower in firms with greater stock liquidity. These results support hypothesis *H1* and suggest that agents' preference for liquidity shifts the optimal contract in more liquid firms away from cash-based compensation and toward equity-based compensation. The economic significance based on Model (3) suggests that a one standard deviation increase in stock liquidity reduces the proportion of cash-based compensation to total compensation by 7% relative to the mean.

Turning to the delta regressions, the coefficient on *Liq* is positive and significant in models (4) to (6) indicating that firms with greater stock liquidity are associated with higher PPS with respect to stock prices. Consistent with the greater informational content of stock prices in more liquid firms, these results support hypothesis *H2* and suggest that firms rely more on stock prices in PPS when stock liquidity is high. A one standard deviation in stock liquidity increases PPS by 4% relative to the mean. The estimated relations between *Cashcomp* (and *LnDelta*) and the control variables are generally consistent with prior studies.

V. ADDITIONAL EVIDENCE AND ROBUSTNESS TESTS

While the above tests are suggestive of a role for stock liquidity in executive compensation, they are cross-sectional in nature and thus suffer from endogeneity concerns. In this section, we address the endogeneity of stock liquidity in several ways. First, we use a two-stage-least squares regression using instrumental variables. Second, we explore the effects of stock splits that result in increases in stock liquidity without any associated change in the firm's underlying fundamentals. Third, we examine changes in cash compensation (and in delta) in response to inter-temporal changes in stock liquidity. Finally, we run several robustness checks and then characterize outcomes that occur through S&P 500 Index additions.

Two-Stage-Least Squares (2SLS) Estimation

In this sub-section, we examine whether our results are robust to correcting for the possible endogeneity of stock liquidity by estimating a two-stage least squares regression.[8] Following Fang et al. (2009), we use two instruments that are correlated with stock liquidity, but are unlikely to be correlated with the error term. In particular, we use the lagged value of liquidity (*LagLiq*) and stock liquidity of the median firm in the industry (*IndLiq*) to capture the industry-driven component of a firm's liquidity. The use of lagged liquidity as an exogenous variable helps mitigate concerns that an unobservable in fiscal year *t* is correlated with both stock liquidity and compensation at time *t*. With regard to industry stock liquidity, Fang et al. point out that the portion of firm *i*'s liquidity that is correlated with the liquidity of its industry is less likely to be correlated with unobservables that affect the outcome variable, which is firm *i*'s compensation in our case. The reduced-form equation for *Liq* (the linear combination of the exogenous variables in the system) becomes:

$$\begin{aligned} Liq = {} & \alpha_0 + \alpha_1 LagLiq + \alpha_2 IndLiq + \alpha_3 Tobin's\ Q + \alpha_4 ROA + \alpha_5 CFO \\ & + \alpha_6 Stock\ return + \alpha_7 ROA\ volatility + \alpha_8 CFO\ volatility \\ & + \alpha_9 Stock\ return\ volatility + \alpha_{10} LogSales + \sum Year + \sum Industry + \varepsilon \end{aligned} \quad (3)$$

We estimate (3) using OLS and we then use the fitted value, *PrLiq*, as an instrumental variable for liquidity in our models related to pay composition and PPS.

<INSERT TABLE 3 ABOUT HERE>

Table 3 presents results of this instrumental variables approach. The coefficients on *LagLiq* and *IndLiq* in model (1) are positive and highly significant, suggesting that the instruments are highly correlated with stock liquidity. The next six models present the second-stage of the 2SLS regression where we regress *Cashcomp* and *LnDelta* on the predicted

[8] We thank an anonymous referee for this suggestion.

component of liquidity from the first stage. Consistent with our primary results from Table 2, the coefficient on *PrLiq* is negative and significant in all *Cashcomp* regressions and positive and significant in all *LnDelta* regressions. Thus, the relation between features of executive compensation and stock liquidity is robust to controlling for endogeneity using a two-stage least squares specification.

Stock Splits as a Shock to Stock Liquidity

In our second test, we use stock-splits as a shock to stock liquidity and examine its effect on cash-based compensation and on delta. Following the seminal work of Fama et al. (1969), several studies have examined the effect of stock splits on stock prices and more recently on bid-ask spreads and stock liquidity (see Maloney and Mulherin 1992 for a summary). Most studies find that stock splits are associated with increases in stock liquidity due to the addition of new investors and the rebalancing by existing investors (e.g., Maloney and Mulherin; Lin et al. 2009). While some studies (Copeland 1979; Conroy et al. 1990) find *increases* in relative bid-ask spreads after stock splits, a carefully-done study by Maloney and Mulherin finds that these inferences might be misleading due to scaling the relative spread by the stock price. Because stock splits are undertaken in response to sharp recent increases in stock prices, the increase in relative spread is driven by the denominator (see also Lakonishok and Lev 1987). Using non-scaled bid-ask spreads and other measures such as the number of investors and size of trades, Maloney and Mulherin document a reduction in transaction costs and an increase in liquidity after stock splits.

Two appealing aspects of this setting are that – (i) stock split events are not clustered in event time (Bernard 1987); and (ii) stock splits have no effect on the underlying fundamentals of

the firm. Thus, stock splits offer a relatively clean test of the effect of stock liquidity on executive compensation.

More directly relevant to our hypothesis is the study by Easley et al. (2001), who find that the increase in uninformed trading after stock splits brings in more informed trading (consistent with Holmstrom and Tirole 1993) and a consequent reduction in information asymmetry (consistent with more informative stock prices). Motivated by the above studies, we expect the post-stock split period to be associated with less cash-based compensation (due to increased liquidity) and higher PPS with respect to stock prices (due to higher stock price informativeness). We begin with univariate evidence in Figure 2.

<INSERT FIGURE 2 ABOUT HERE>

Consistent with the findings from recent studies (e.g., Maloney and Mulherin 1992; Lin et al. 2009), Panel A of Figure 2 shows a significant increase in stock liquidity in the 3 years after stock splits relative to the 3 years before after deleting the year of the split. Further, stock liquidity is increasing in the period leading up to the stock split decision, consistent with these decisions following a period of continued good firm performance. Panel B provides univariate evidence of changes in *Cashcomp* and *Delta* around the stock splits. The median proportion of cash-based compensation to total annual compensation takes a significant and permanent dip starting from the year after the stock split. Similarly, the median *LnDelta* increases in the years after the split as compared to the years before. Further, there is an increase in *LnDelta* in the period leading up to the split.

<INSERT TABLE 4 ABOUT HERE>

Table 4 presents multivariate evidence, where *Post Split* is an indicator variable that denotes the post stock-split period.[9] In addition to the standard controls included in the specifications, we include additional controls for the firm's prior year performance because stock splits are a response to recent increases in firm performance. In particular, we include prior year's ROA (*Lag ROA*), prior year's cash-flow from operations (*Lag CFO*) and prior year stock return (*Lag Stock return*) in the regressions. The coefficient on *Post Split* is negative and highly significant in all the *Cashcomp* regressions, suggesting that increased liquidity due to stock splits results in a significant reduction in the proportion of cash-based compensation to total compensation. Further, in all the *LnDelta* regressions, the coefficient on *Post Split* is positive and significant, indicating that stock splits result in an increased reliance on stock prices in PPS. Thus, increases in stock liquidity after stock splits are associated with decreases in the proportion of cash compensation to total compensation and with increases in PPS with respect to stock prices.

Intertemporal Relation between *Cashcomp*, *Delta* and *Liq*

We next analyze the intertemporal relation between stock liquidity and cash-based compensation as a third test to address the endogeneity of stock liquidity. In particular, we ask whether the declining ratio of cash-based compensation to total compensation and increasing PPS with respect to stock prices over time are related to increasing stock liquidity over time. In addition to providing time-series evidence of the link between liquidity and cash-based compensation and PPS, these firm-specific changes regressions also help alleviate concerns about correlated variables.

[9] Our results are robust to using either two years or five years around the split year to define the post-split period.

<INSERT TABLE 5 ABOUT HERE>

In particular, we compute firm-specific changes in *Cashcomp*, *LnDelta*, *Liq* and in the other variables. We use annual, three-year and five-year periods to compute changes. Table 5 presents the results based on the strictest empirical specification with executive fixed effects. The first two specifications pertain to annual changes, the next two to three-year changes and the last two to five-year changes. The first regression in each period pertains to $\Delta Cashcomp$ and the next to $\Delta LnDelta$. The coefficient on ΔLiq is negative and significant at the 1% level in the $\Delta Cashcomp$ regression across every horizon (annual, three-year and five-year). These results provide strong evidence that firm-specific declines in cash-based compensation are associated with firm-specific increases in stock liquidity. These results help establish a connection between increasing stock liquidity over time as documented in the market microstructure literature and declining cash-based compensation over time as documented in the executive compensation literature. Further, the coefficient on ΔLiq is positive and significant at the 1% level in all the $\Delta LnDelta$ regressions indicating that firm-specific increases in PPS with respect to stock price are strongly associated with firm-specific increases in stock liquidity. These results provide confirmatory evidence in favor of our cross-sectional results.

Before turning to our robustness tests, we first explore situations where greater stock liquidity actually results in less informative prices owing to greater increases in uninformed trading relative to informed trading. Several studies have found that firms added to the S&P 500 Index experience a significant increase in stock liquidity (e.g., Shleifer 1986; Beneish and Whaley 1996), but that these increases in liquidity are associated with higher trading by investors who trade for tracking and liquidity reasons, such as index funds, rather than trading for informational reasons. Vijh (1994) and Barberis et al. (2005) find that stock prices of firms

added to the S&P 500 Index experience decreases in firm-specific information. Therefore, we examine changes in the proportion of cash-based compensation and in *PPS* before versus after the firm is added to the S&P 500 Index. As additions result in increases in stock liquidity but decreases in stock price informativeness, this offers us a unique experiment to examine the conflicting theoretical predictions about the role of stock liquidity in PPS.[10] As Index additions increase stock liquidity, we expect them to be associated with less cash-based compensation. Further, as these additions reduce stock price informativeness, we expect them to be followed by a reduction in the use of stock prices in PPS.

We obtain our sample of S&P 500 Index additions from 1993 to 2006 from two sources – Barberis et al. (2005) for additions from 1993 to 2000 and directly from S&P for 2001 onwards.[11] The final sample contains 2,419 firm-year observations for 242 additions between 1992 and 2007. We define an indicator variable, *Post Addition* to denote the post-Index addition period. Because we expect firms to rely less on cash-based compensation and also less on stock prices in PPS after S&P 500 Index additions, we expect *Post Addition* to be negative in the *Cashcomp* and the *LnDelta* regressions.

<INSERT TABLE 6 ABOUT HERE>

Table 6 presents the above results. Consistent with our prediction, the coefficient on *Post Addition* is negative in all the *Cashcomp* regressions but highly significant only in the median

[10] Although one could make an argument that the exact opposite effects should be observed during Index deletions, we do not examine deletions for several reasons. There is an important difference between why firms are added to an Index versus why they are deleted (see Barberis et al. 2005 for a detailed discussion). The primary criterion that S&P uses in selecting a firm to be added is sector representation. The goal of the S&P index is to make the Index representative of the U.S. economy and not a signal about the firm's future cash flows. Hence, additions can be treated as relatively exogenous to the firm. However, most deletions from the Index are due to poor sustained performance, upcoming bankruptcy or merger related activities. Deleted firms often do not survive, which poses significant survivorship biases. Thus, the decision to drop a firm from the Index is a manifestation of ongoing changes, and more likely to be endogenous to firm characteristics.

[11] See http://pages.stern.nyu.edu/~jwurgler/

regression. It is possible that the insignificance in the OLS regressions might be driven by outliers. Consistent with this conjecture, we find (in unreported tests) that the coefficient on *Post Addition* is negative and significant in both the OLS and the executive-fixed effects specifications when the dependent variable is transformed to decile ranks. Thus, there is some reasonable evidence that firms rely less on cash-based compensation after addition to the S&P 500 Index.

Turning to the PPS results, the coefficient on *Post Addition* is again negative in all the *LnDelta* regressions and significant only in the median regression. Thus, there is again moderate evidence that firms rely less on stock prices for *PPS* in response to S&P 500 Index additions that decrease stock price informativeness. These results are consistent with Calcagno and Heider (2007) who show that instances where greater stock liquidity results in lower stock price informativeness leads to lower *PPS*. However, we interpret these results as exploratory.

Robustness Tests

Using Alternative Measures of PPS

Our earlier results follow the framework of Core and Guay (1999) and compute PPS as the change in the value of the manager's equity portfolio for a 1% increase in the stock price. In this section, we examine the robustness of our results to two alternative measures of *PPS*. First, we follow Edmans et al. (2009) and scale *Delta* by total annual compensation (*ScaledDelta*). Second, we use the Jensen and Murphy (1990) measure (*JM*) which estimates the change in total CEO wealth for a $1,000 change in shareholder wealth.

<INSERT PANEL A OF TABLE 7 ABOUT HERE>

Results based on these alternate measures are presented in Panel A of Table 7. The first three specifications present *ScaledDelta* while the next three depict *JM*. The coefficient on *Liq* is positive and significant in all six specifications, indicating that our inferences are robust to using

alternative measures of estimating PPS with respect to stock prices. Further, in unreported tests, we find that our results are also robust to estimating PPS by regressing changes in CEO wealth on changes in shareholder wealth (Jensen and Murphy 1990) and interacting the latter with stock liquidity. We do not use this specification for the primary results because it entails using stock returns on both the left hand side and the right hand side of the PPS regression.

Alternative Measures of Stock Liquidity

We examine the sensitivity of our results to using alternative measures of stock liquidity. We follow Fang et al. (2009) and use three additional measures: the relative bid-ask spread, the Amihud (2002) measure of illiquidity and the percentage of zero-returns first used by Lesmond et al. (1999). We combine these three measures into a composite measure using principal components and denote this measure *LiqPC*.[12] As the three measures denote stock illiquidity, we multiply *LiqPC* by minus 1 to indicate greater stock liquidity.

<INSERT PANEL B OF TABLE 7 ABOUT HERE>

Panel B of Table 7 presents the results. The coefficient on *LiqPC* is negative and significant in all three *Cashcomp* regressions, indicating that the composite measure of stock liquidity is negatively associated with cash-based compensation. Further, *LiqPC* is positive and significant in all specifications in the *LnDelta* regressions, indicating that the reliance on stock prices in PPS is high when stock liquidity, as captured by *LiqPC*, is higher. Overall, our results are robust to using alternate measures of stock liquidity.

[12] The principal component explains 80% of the overall variation in the three measures. The loadings on the three measures are 0.917, 0.838 and 0.835, respectively.

Using CEO Cash Compensation

Our earlier results follow the framework of Core and Guay (1999) and use changes in total CEO wealth to measure delta. In this section, we examine the robustness of our results to using CEO cash compensation as in Lambert and Larcker (1987) and Sloan (1993). Sloan, in particular, shows that CEO cash compensation is more sensitive to earnings than to stock prices because earnings can shield the CEO from fluctuations in compensation that are due to market-wide movements. While earnings might display this feature on average, our argument is that the relative superiority of earnings compared to stock prices will be attenuated in firms with greater stock liquidity. In this sense, increased liquidity helps resolve the negative aspects of stock prices as a performance measure vis-à-vis earnings by incorporating more information about the manager's actions in the stock price.[13] To test this prediction, we regress changes in CEO cash compensation on changes in shareholder wealth, changes in *ROA* and changes in *CFO*. We also interact each of these performance measures with *Liq*. We also interact each performance measure with the ratio of the standard deviation of earnings to the standard deviation of stock returns.

In unreported results, we find that CEO cash compensation is, on average, more sensitive to accounting information than market performance (consistent with Lambert and Larcker 1987; Sloan 1993). Consistent with our predictions, however, we find that the effect of stock price (earnings) on CEO cash compensation is larger (smaller) when stock liquidity is higher. Thus, greater stock liquidity seemingly resolves the negative aspects of stock prices as a performance measure by impounding more information about the manager's actions into the stock price.

[13] We again thank a referee for encouraging us to explore this interpretation.

Controlling for the Influence of Other Unobservable Performance Measures

It is possible that our inferences might be confounded by unobservable performance measures other than stock prices, earnings and cash flows. To examine this possibility, we follow Hayes and Schaefer (2000) who derive implications of unobservable performance measures used in contracts for the relation between executive compensation and future firm performance (also see Bushman and Smith 2001). Hayes and Schaefer argue that if firms are optimally using unobservable measures of performance that are correlated with future observable measures of performance, then current compensation should be positively associated with future performance measures. We therefore include both future stock price performance, as well as future earnings performance, in the *Cashcomp* and *LnDelta* specifications to capture the influence of unobservable performance measures. In unreported tests, we find that the coefficient on *Liq* continues to remain negative and significant in the *Cashcomp* regressions and positive and significant in the *LnDelta* specifications, suggesting that the role of stock liquidity in executive compensation is robust to controlling for the effect of unobservable measures of performance.

VI. CONCLUSION

The main contribution of our study is to propose stock liquidity as an important explanation for two important trends in executive compensation highlighted by Bushman and Smith (2001): (i) the declining importance of cash-based compensation in total compensation and (ii) the increasing reliance on stock prices relative to earnings in executive compensation. Motivated by the market microstructure literature that finds that firms with greater stock liquidity have more informative prices, we take an optimal contracting perspective to empirically examine the role of stock liquidity in managerial compensation. Further, we rely on

theories that argue that agents' preference for greater personal liquidity shifts the composition of annual pay towards equity-based compensation and away from cash compensation in firms with greater stock liquidity. We find cross-sectional as well as inter-temporal evidence that firms with greater stock liquidity rely less on cash-based compensation as part of total compensation in annual contracts. Further, we find that the reliance on stock prices in designing executive compensation is higher for firms with greater stock liquidity.

To support these claims, we provide an assortment of analyses. We use stock splits as an experiment where there is a shock to stock liquidity that leaves the underlying fundamentals of the firm unaltered and find that stock splits reduce the proportion of cash-based compensation to total compensation and increase executive compensation with respect to stock prices. We use a two-stage-least squares specification to mitigate concerns regarding endogeneity and again find consistent evidence. To provide time-series evidence, we use changes regressions and find that firm-specific changes in stock liquidity (measured at different intervals) are negatively and significantly associated with changes in cash-based compensation and positively and significantly associated with changes in PPS. Overall, we find that market microstructure theories related to the role of stock liquidity serve to materially clarify our understanding of two important trends in the managerial compensation literature.

References

Aggarwal, R., and A. Samwick. 1999. The other side of the trade-off: The impact of risk on executive compensation. *Journal of Political Economy* 107 (1): 65–105.

_____. 2002. The other side of the trade-Off: The impact of risk on executive compensation – A Reply. Dartmouth College working paper.

Amihud, Y. 2002. Illiquidity and stock returns: cross-section and time-series effects. *Journal of Financial Markets* 5 (1): 31–56.

Banker, R. D., and S. M. Datar. 1989. Sensitivity, precision, and linear aggregation of signals for performance evaluation. *Journal of Accounting Research* 27 (1): 21-39.

Banker, R.D.; R. Huang and R. Natarajan. 2009. Incentive contracting and value relevance of earnings and cash flows. *Journal of Accounting Research* 47 (3): 647-678.

Barberis, N., A. Shleifer and J. Wurgler. 2005. Comovement. *Journal of Financial Economics* 75 (2): 283–317.

Beneish, M., and R. Whaley. 1996. An anatomy of the "S&P Game": the effects of changing the rules. *Journal of Finance* 51(5): 1909–1930.

Bernard, V. 1987. Cross-sectional dependence and problems in inference in market-based accounting research. *Journal of Accounting Research* 25 (1): 1-48.

Bushman, R. M., E. Engel, J.C. Milliron and A. J. Smith. 1998. An empirical investigation of trends in the absolute and relative use of earnings in determining cash compensation of CEOs. UNC working paper

Bushman, R., E. Engel and A. Smith. 2006. An analysis of the relation between the stewardship and valuation roles of earnings. *Journal of Accounting Research* 44 (1): 53–83.

Bushman, R. M., and A. J. Smith. 2001. Financial accounting information and corporate governance. *Journal of Accounting & Economics* 32 (1-3): 237-333.

Calcagno, R., and F. Heider. 2007. Market-based compensation, price informativeness and short-term trading. ECB Working Paper No. 735.

Chava, S., and A. Purnanandam. 2010. CEOs versus CFOs: Incentives and corporate policies. *Journal of Financial Economics* 97(2): 263-278.

Chordia, T., R..Roll, and A. Subrahmanyam. 2008. Liquidity and market efficiency. *Journal of Financial Economics* 87 (2): 249-268.

Copeland, T. 1979. Liquidity changes following stock splits. *The Journal of Finance* 34 (1): 115-141.

Conroy, R.M., R.S. Harris and B. A. Benet. 1990. The effects of stock splits on bid-ask spreads. *The Journal of Finance* 45 (4): 1285-1295.

Core, J., and W. Guay. 1999. The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting and Economics* 28 (2): 151 – 184.

Core, J., and W. Guay. 2002a. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research* 40 (3): 613–630.

Core, J., and W. Guay. 2002b. The other side of the trade-off: The impact of risk on executive compensation, a revised comment. University of Pennsylvania working paper.

Core, J., W. Guay and R. Verrecchia. 2003. Price versus non-price performance measures in optimal CEO compensation contracts. *The Accounting Review* 78 (4): 957–981.

Dai, Z., L. Jin and W. Zhang. 2010. Risk and incentive: An event study approach. University of Texas at Dallas working paper

De Long, J., A. Shleifer, L. Summers and R. Waldmann. 1990. Noise trader risk in financial markets. *Journal of Political Economy* 98 (4), 703–738.

Demsetz, H., and K. Lehn. 1985. The structure of corporate ownership: Causes and consequences. *Journal of Political Economy* 93 (6): 1155-1177.

Easley, D., and M. O'Hara. 2004. Information and the cost of capital. *Journal of Finance* 59 (4): 1553–1583.

Easley D., M. O'Hara and G. Saar. 2001. How stock splits affect trading: A microstructure approach. *Journal of Financial and Quantitative Analysis* 36 (1): 25-51.

Edmans, A., X. Gabaix and A. Landier. 2009. A multiplicative model of optimal CEO incentives in market equilibrium. *Review of Financial Studies* 22 (12): 4881-4917.

Fama, E., L. Fisher, M. Jensen and R. Roll. 1969. The adjustment of stock prices to new information. *International Economic Review* 10 (1): 1-21.

Fang, V., T. Noe and S. Tice. 2009. Stock market liquidity and firm value. *Journal of Financial Economics* 94 (1): 150 – 169.

Ferreira, M., P. Laux and G. Markarian. 2008. Institutional trading, information and executive compensation. Universidade Nova de Lisboa working paper.

Garvey, G.T. 1997. Marketable incentive contracts and capital structure relevance. *Journal of Finance* 52(1): 353-378.

Garvey, G., and T. Milbourn. 2003. Incentive compensation when executives can hedge the market: evidence of relative performance evaluation in the cross-section. *Journal of Finance* 58 (4): 1557–1582.

Garvey, G. and P. Swan. 2002. Agency problems are ameliorated by stock market liquidity: Monitoring, information and the use of stock-based compensation. UNSW School of Banking and Finance working paper.

Gjesdal, F. 1981. Accounting for stewardship. *Journal of Accounting Research* 19 (1): 208–231.

Grossman, S. and J. Stiglitz. 1980. On the impossibility of informationally efficient markets. *American Economic Review* 70 (3): 393–408.

Hayes, R. and S. Schaefer. 2000. Implicit contracts and the explanatory power of top executive compensation for future performance. *RAND Journal of Economics* 31 (2): 273–293.

Holmstrom, B. 1979. Moral hazard and observability. *Bell Journal of Economics* 10 (1): 74–91.

Holmstrom, B., and J. Tirole. 1993. Market liquidity and performance measurement. *Journal of Political Economy* 101 (4): 678–709.

Jayaraman, S., and T. Milbourn. 2011. Financial misreporting and executive compensation: The *Qui Tam* statute. Washington University working paper

Jensen, M. C., and K. J. Murphy. 1990. Performance pay and top-management incentives. *Journal of Political Economy* 98 (2): 225-64.

Jiang, J., K. Petroni and I.Y. Wang. 2010. CFOs and CEOs: Who have the most influence on earnings management? *Journal of Financial Economics* 96 (3): 513-526.

Kang, Q., and Q. Liu. 2006. A missing link in the risk-incentive tradeoff. University of Miami working paper.

Kyle, A. 1985. Continuous auctions and insider trading. *Econometrica* 53 (6): 1315–1336.

Lakonishok, J., and B. Lev. 1987. Stock splits and stock dividends: Why, who, and when. *The Journal of Finance* 42 (4): 913-932.

Lambert, R. 1993. The use of accounting and security price measures of performance in managerial compensation contracts, a discussion. *Journal of Accounting and Economics* 16 (1-3): 101–123.

Lambert, R., and D. Larcker. 1987. An analysis of the use of accounting and market measures of performance in executive-compensation contracts. *Journal of Accounting Research* 25 (S): 85-129.

Lesmond, D., J. Ogden, and C. Trzcinka. 1999. A new estimate of transaction costs. *Review of Financial Studies* 12 (5): 1113 – 1141.

Lin, J.C., A.K. Singh and W. Yu. 2009. Stock splits, trading continuity, and the cost of equity capital. *Journal of Financial Economics* 93 (3): 474-489.

Lo, A. W., and J. Wang. 2000. Trading volume: Definitions, data analysis, and implications of portfolio theory. *Review of Financial Studies* 13 (2): 257–300.

Maloney, M.T., and J.H. Mulherin. 1992. The effects of splitting on the ex – A microstructure reconciliation. *Financial Management* 21 (4): 44-59.

Paul, J. 1992. On the efficiency of stock-based compensation. *Review of Financial Studies* 5 (3): 471-502.

Petersen, M. A. 2009. Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies* 22 (1): 435-80.

Prendergast, C. 2000. What trade-off of risk and incentives? *American Economic Review* Papers and Proceedings 90 (2): 421–25.

_____. 2002. The tenuous trade-off between risk and incentives. *Journal of Political Economy* 110 (5): 1071–102.

Shleifer, A. 1986. Do demand curves for stock slope down? *Journal of Finance* 41(3): 579–590.

TABLE 1
Descriptive Statistics

Panel A: Main variables

Variables	Obs.	Mean	Median	Std. dev	Min	Max
Salary	21,750	624.825	574.885	318.038	24.620	1750.000
Bonus	21,750	592.410	269.908	971.797	0.000	6187.000
Total compensation	21,750	4110.820	2127.690	5543.141	179.343	33436.801
Cashcomp	21,750	0.504	0.465	0.291	0.018	1.000
Delta	21,750	714.547	149.160	1993.445	0.525	15116.606
Liq	21,750	-5.479	-5.472	0.870	-7.708	-3.532
Tobin's Q	21,750	2.002	1.541	1.335	0.796	8.383
ROA	21,750	0.052	0.052	0.101	-0.405	0.330
CFO	21,750	0.108	0.100	0.102	-0.220	0.437
Stock return	21,750	0.155	0.097	0.475	-0.755	2.141
ROA volatility	21,750	0.052	0.029	0.067	0.001	0.396
CFO volatility	21,750	0.057	0.041	0.053	0.003	0.300
Stock return volatility	21,750	0.484	0.356	0.448	0.066	2.951
Sales	21,750	4138.762	1161.209	8506.966	24.646	56114.000

Panel B: Correlations

	Cashcomp	LnDelta	Liq	Tobin's Q	ROA	CFO	Stock ret	ROA vol	CFO vol	Stock ret vol	Log sales
Cashcomp	1.00										
LnDelta	-0.24**	1.00									
Liq	-0.33**	0.29**	1.00								
Tobin's Q	-0.13**	0.38**	0.25**	1.00							
ROA	-0.01	0.28**	0.09**	0.60**	1.00						
CFO	-0.03**	0.22**	0.09**	0.51**	0.67**	1.00					
Stock ret	0.02**	0.18**	-0.03**	0.26**	0.21**	0.19**	1.00				
ROA vol	-0.07**	0.01*	0.37**	0.26**	-0.03**	0.08**	-0.07**	1.00			
CFO vol	-0.01*	0.07**	0.34**	0.24**	0.09**	0.11**	-0.04**	0.64**	1.00		
Stock ret vol	-0.08**	0.14**	0.39**	0.16**	0.00	0.01*	0.03**	0.45**	0.42**	1.00	
Log sales	-0.22**	0.21**	-0.02**	-0.14**	0.02**	0.02**	0.04**	-0.35**	-0.33**	-0.25**	1.00

The sample includes 21,750 firm-year observations and covers the period from 1992 to 2007. Salary and Bonus represent the CEO's yearly salary and bonus values. Total compensation includes salary, bonus, restricted stock grants, long-term payouts and the Black-Scholes value of option grants. Cashcomp is the ratio of cash-based compensation (i.e., salary and bonus) to total compensation. Delta is the CEO's delta for a given year and measures the sensitivity of the CEO's wealth to a one percent change in the stock price, computed as per the methodology of Core and Guay (1999, 2002a). Liq is the measure of stock liquidity and is defined as the log of turnover. Turnover is defined as the ratio of total shares traded annually divided by total shares outstanding. Tobin's Q is measured as the ratio of the market value to the book value of assets. ROA represents return on assets and is defined as the ratio of income before extraordinary items scaled by total assets. CFO indicates operating cash flows and is defined as cash flow from operations scaled by total assets. Stock return is the annual stock return for the firm over its fiscal year. ROA volatility, CFO volatility and Stock return volatility are the standard deviation of ROA, CFO and Stock return, respectively, and are computed based on five annual observations. Sales denotes annual sales in millions. Compensation data are in thousands. ** denotes significance at the 5% level or lower while * denotes significance at the 10% level. All other correlations are insignificant.

TABLE 2
Relation between Executive Compensation and Stock Liquidity

	Cashcomp			*LnDelta*		
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	.680***	.725***	.954***	3.114***	3.082***	3.351*
	(.049)	(.078)	(.164)	(.301)	(.839)	(1.844)
Liq	-.091***	-.069***	-.041***	.385***	.303***	.208***
	(.003)	(.004)	(.007)	(.019)	(.035)	(.033)
Tobin's Q	-.035***	-.023***	-.018***	.369***	.363***	.220***
	(.002)	(.003)	(.004)	(.012)	(.018)	(.013)
ROA	.204***	.195***	.051	1.408***	1.616***	1.180***
	(.029)	(.035)	(.042)	(.178)	(.205)	(.143)
CFO	.030	.020	-.035	-.086	-.197	.178
	(.028)	(.032)	(.037)	(.171)	(.206)	(.134)
Stock return	.030***	.012**	.018***	.329***	.368***	.322***
	(.005)	(.005)	(.005)	(.028)	(.025)	(.019)
ROA volatility	-.107**	-.099*	-.037	-1.163***	-1.267***	-.747**
	(.045)	(.056)	(.080)	(.275)	(.374)	(.329)
CFO volatility	.064	.121*	-.056	.723**	.724	.864**
	(.052)	(.067)	(.089)	(.318)	(.477)	(.350)
Stock return volatility	-.019***	-.012*	-.027**	.173***	.160***	.119***
	(.005)	(.007)	(.011)	(.032)	(.043)	(.040)
Log sales	-.057***	-.051***	-.019**	.317***	.348***	.363***
	(.002)	(.002)	(.008)	(.009)	(.017)	(.039)
Year effects	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y
Executive effects	N	N	Y	N	N	Y
Obs.	21,750	21,750	21,750	21,750	21,750	21,750
Adj. R²		.221	.459		.336	.839

The dependent variable in Models (1) to (3) is Cashcomp which denotes the proportion of cash-based compensation to total annual compensation, while that in Models (4) to (6) is LnDelta which represents the log of the CEO's delta. Liq indicates stock liquidity. Tobin's Q stands for the ratio of the market value to the book value of assets. ROA represents return on assets. CFO indicates operating cash flows. Stock return is the annual return for the firm. ROA volatility, CFO volatility and Stock return volatility are the standard deviations of ROA, CFO and Stock return respectively. Log sales is the log of annual sales. Detailed variable definitions are in Table 1. Models (1) and (4) present results from median regression with year fixed effects and industry fixed effects defined at the 2 digit SIC level. Models (2) and (5) present results from an OLS regression with year fixed effects, industry fixed effects defined at the 2 digit SIC level and robust standard errors clustered by executive. Models (3) and (6) present results from an OLS regression that includes executive fixed effects in addition to the year and industry fixed effects. Robust standard errors that are clustered by executive are presented in parentheses under the coefficients. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 3
Two-Stage Least Squares (2SLS) Regressions

	1st stage	*2nd stage*					
	Liq	*Cashcomp*			*LnDelta*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Const.	-.090	.584***	.651***	- .300***	3.922***	3.768***	8.392***
	(.065)	(.050)	(.080)	(.105)	(.288)	(.855)	(.650)
LagLiq	.741***						
	(.005)						
IndLiq	.270***						
	(.007)						
PrLiq		-.103***	-.079***	-.043***	.484***	.395***	.276***
		(.003)	(.005)	(.008)	(.020)	(.041)	(.036)
Tobin's Q	.019***	-.032***	-.022***	-.018***	.356***	.355***	.221***
	(.003)	(.002)	(.003)	(.004)	(.011)	(.018)	(.013)
ROA	.329***	.222***	.196***	.045	1.479***	1.601***	1.185***
	(.041)	(.029)	(.035)	(.041)	(.164)	(.205)	(.144)
CFO	-.089**	.028	.021	-.036	-.092	-.207	.185
	(.038)	(.027)	(.032)	(.037)	(.157)	(.206)	(.134)
Stock return	.078***	.030***	.011**	.019***	.319***	.372***	.320***
	(.007)	(.004)	(.005)	(.005)	(.026)	(.025)	(.018)
ROA volatility	.146**	-.083*	-.082	-.028	-1.375***	-1.428***	-.824**
	(.063)	(.044)	(.056)	(.080)	(.254)	(.375)	(.327)
CFO volatility	.040	.104**	.145**	-.050	.503*	.517	.763**
	(.069)	(.051)	(.068)	(.089)	(.294)	(.479)	(.350)
Stock return volatility	.046***	-.014***	-.009	-.027**	.151***	.131***	.106***
	(.008)	(.005)	(.007)	(.011)	(.030)	(.043)	(.039)
Log sales	.012***	-.055***	-.051***	-.018**	.309***	.340***	.347***
	(.002)	(.002)	(.002)	(.008)	(.009)	(.017)	(.039)
Year effects	Y	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y	Y
Executive effects	N	N	N	Y	N	N	Y
Obs.	21,745	21,745	21,745	21,745	21,745	21,745	21,745
Adj. R²	.866		.221	.458		.339	.839

The dependent variable in model (1) is stock liquidity (Liq). The dependent variable in Models (2) to (4) is Cashcomp which denotes the proportion of cash-based compensation to total annual compensation while that in Models (5) to (7) is LnDelta which represents the log of the CEO's delta. LagLiq denotes lagged liquidity and IndLiq indicates the median liquidity in the industry respectively. PrLiq is the predicted value from the first-stage regression of model (1). All other variables are defined similar to that in Table 2. Robust standard errors that are clustered by executive are presented in parentheses under the coefficients. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 4
Effect of Stock Splits on Executive Compensation

	Cashcomp			*LnDelta*		
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	.885***	.890***	.622***	2.072***	1.415***	1.236**
	(.136)	(.055)	(.196)	(.715)	(.381)	(.542)
Post Split	-.055***	-.056***	-.067***	.322***	.240***	.522***
	(.012)	(.011)	(.018)	(.063)	(.061)	(.056)
Tobin's Q	-.041***	-.032***	-.019**	.323***	.326***	.146***
	(.005)	(.006)	(.008)	(.028)	(.037)	(.024)
ROA	.224**	.202**	.075	.412	.030	.108
	(.099)	(.097)	(.109)	(.516)	(.585)	(.303)
CFO	.054	.073	-.025	-.829*	-.808*	.094
	(.087)	(.082)	(.100)	(.453)	(.453)	(.268)
Stock return	.081***	.037***	.028*	.349***	.339***	.480***
	(.013)	(.013)	(.016)	(.068)	(.064)	(.043)
Lag ROA	-.030	.009	-.106	.879*	1.034*	.759***
	(.094)	(.099)	(.118)	(.491)	(.539)	(.251)
Lag CFO	-.051	-.064	-.147	.066	-.206	.198
	(.084)	(.087)	(.107)	(.439)	(.474)	(.257)
Lag Stock return	.010	-.007	-.001	.089	.113*	.219***
	(.013)	(.013)	(.014)	(.067)	(.065)	(.042)
ROA volatility	-.510***	-.503***	-.106	2.471***	1.917*	-.463
	(.145)	(.142)	(.241)	(.760)	(1.022)	(.630)
CFO volatility	-.010	.206	.250	-2.163***	-1.937	-.622
	(.158)	(.186)	(.263)	(.828)	(1.248)	(.829)
Stock return volatility	-.089***	-.066***	-.039	.323***	.381***	.047
	(.017)	(.017)	(.030)	(.090)	(.116)	(.095)
Log sales	-.053***	-.052***	-.010	.269***	.323***	.459***
	(.004)	(.006)	(.026)	(.023)	(.041)	(.070)
Year effects	N	N	N	N	N	N
Industry effects	Y	Y	Y	Y	Y	Y
Executive effects	N	N	Y	N	N	Y
Obs.	2,978	2,978	2,978	2,978	2,978	2,978
Adj. R²		.172	.475		.303	.898

The dependent variable is Cashcomp in models (1) to (3) and log of delta in models (4) to (6). Post Split indicates the three years after versus the three years before the year of the stock split. The year of the stock split is deleted from either group. All other variables are defined similar to that in Table 2. Lag ROA, Lag CFO and Lag Stock return denote the lagged values of ROA, CFO and Stock return, respectively. Robust standard errors that are clustered by executive are presented in parentheses under the coefficients. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 5
Intertemporal Relations

	Annual		Three-year		Five-year	
	ΔCashcomp	*ΔLnDelta*	*ΔCashcomp*	*ΔLnDelta*	*ΔCashcomp*	*ΔLnDelta*
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	1.041***	1.156	.761***	-.733	.426***	2.283***
	(.171)	(1.356)	(.179)	(1.373)	(.160)	(.791)
ΔLiq	-.036***	.181***	-.043***	.177***	-.050***	.199***
	(.008)	(.038)	(.009)	(.048)	(.011)	(.058)
ΔTobin's Q	-.015***	.216***	-.018***	.212***	-.016***	.218***
	(.004)	(.014)	(.004)	(.017)	(.005)	(.021)
ΔROA	.063	.939***	.098	.951***	.081	.996***
	(.048)	(.165)	(.061)	(.223)	(.070)	(.293)
ΔCFO	-.023	.217	.037	.002	.050	-.051
	(.043)	(.141)	(.053)	(.203)	(.061)	(.251)
ΔStock return	.026***	.273***	.028***	.272***	.022***	.242***
	(.006)	(.021)	(.007)	(.025)	(.008)	(.032)
ΔROA volatility	-.078	-1.065***	-.082	-1.560***	.035	-1.215*
	(.091)	(.367)	(.125)	(.489)	(.150)	(.702)
ΔCFO volatility	-.121	1.079***	-.175	1.019*	-.098	.762
	(.101)	(.386)	(.131)	(.558)	(.163)	(.793)
ΔStock return volatility	-.028**	.126***	-.029*	.175**	-.018	.155
	(.012)	(.048)	(.017)	(.072)	(.019)	(.094)
ΔLog sales	-.029***	.289***	-.025**	.389***	-.029**	.406***
	(.009)	(.044)	(.011)	(.054)	(.013)	(.069)
Year effects	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y
Executive effects	Y	Y	Y	Y	Y	Y
Obs.	18,129	18,129	13,342	13,342	9,707	9,707
Adj. R²	.444	.813	.433	.804	.461	.812

The dependent variables in Models (1), (3) and (5) are *ΔCashcomp* where *Δ* is defined over annual periods in Model (1), three-year periods in Model (3) and five-year periods in Model (5). The dependent variables in Models (2), (4) and (6) are *ΔLnDelta* where *Δ* is analogously defined. ΔLiq indicates change in stock liquidity. ΔTobin's Q stands for the change in the ratio of the market value to the book value of assets. ΔROA represents change in return on assets. ΔCFO indicates change in operating cash flows. ΔStock return is the change in the annual return for the firm. ΔROA volatility, ΔCFO volatility and ΔStock return volatility are the changes in the standard deviations of ROA, CFO and Stock return respectively. ΔLog sales is the change in the log of annual sales. Detailed variable definitions are in Table 1. All regressions include executive fixed effects, year fixed effects and industry fixed effects defined at the 2 digit SIC level. The robust standard errors are clustered by executive in all the models and are presented in parentheses under the coefficients. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 6
Effect of S&P 500 Index Additions

	Cashcomp			*LnDelta*		
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	.630***	.631***	.649***	-1.952**	-1.658***	1.794***
	(.080)	(.123)	(.170)	(.839)	(.563)	(.501)
Post Addition	-.045***	-.032	-.039	-.201*	-.119	-.016
	(.010)	(.022)	(.025)	(.109)	(.155)	(.082)
Tobin's Q	-.018***	-.007	-.030***	.325***	.323***	.206***
	(.003)	(.009)	(.008)	(.034)	(.042)	(.025)
ROA	.186***	.201	.144	.274	-.176	.456
	(.053)	(.126)	(.144)	(.551)	(.527)	(.352)
CFO	-.043	-.140	-.238**	-.305	-.327	.115
	(.050)	(.103)	(.107)	(.523)	(.512)	(.285)
Stock return	.021***	.001	.019	.302***	.329***	.326***
	(.008)	(.016)	(.016)	(.083)	(.072)	(.045)
ROA volatility	-.186***	-.054	.010	.635	-.478	-.367
	(.072)	(.156)	(.180)	(.754)	(.829)	(.741)
CFO volatility	-.263***	-.120	.080	1.597*	.264	.163
	(.089)	(.217)	(.298)	(.927)	(1.286)	(.727)
Stock return volatility	-.043***	-.039	-.040	.524***	.559***	.229***
	(.009)	(.024)	(.032)	(.098)	(.129)	(.077)
Log sales	-.014***	-.010	.018	.487***	.455***	.379***
	(.004)	(.013)	(.024)	(.040)	(.066)	(.078)
Year effects	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y
Executive effects	N	N	Y	N	N	Y
Obs.	2,419	2,419	2,419	2,419	2,419	2,419
Adj. R²		.211	.458		.355	.876

The dependent variable is Cashcomp in models (1) to (3) and log of delta in models (4) to (6). Post Addition indicates the period after S&P 500 Index additions. The year of addition is deleted from either group. All other variables are similar to those defined in Table 2. Robust standard errors that are clustered by executive are presented in parentheses under the coefficients. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 7
Robustness Tests

Panel A: Alternative measures of PPS

	ScaledDelta			*JM*		
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	.672***	.677***	.804***	6.635***	6.470***	5.182***
	(.035)	(.146)	(.234)	(.287)	(1.028)	(1.702)
Liq	.037***	.023***	.018***	.233***	.156***	.083***
	(.002)	(.005)	(.005)	(.018)	(.035)	(.029)
Tobin's Q	.035***	.043***	.022***	-.064***	-.028	-.009
	(.001)	(.003)	(.002)	(.011)	(.019)	(.010)
ROA	.197***	.238***	.117***	.773***	.953***	.433***
	(.021)	(.031)	(.022)	(.170)	(.189)	(.112)
CFO	.00005	-.024	-.020	.089	-.119	.110
	(.020)	(.031)	(.020)	(.163)	(.200)	(.121)
Stock return	.042***	.038***	.036***	.108***	.128***	.061***
	(.003)	(.004)	(.003)	(.026)	(.022)	(.015)
ROA volatility	-.135***	-.190***	-.122**	-1.765***	-1.700***	-.291
	(.032)	(.053)	(.056)	(.261)	(.358)	(.293)
CFO volatility	.075**	.092	.115**	2.615***	2.573***	.338
	(.037)	(.068)	(.055)	(.303)	(.461)	(.317)
Stock return volatility	.020***	.019***	.016***	.199***	.239***	.061*
	(.004)	(.006)	(.006)	(.031)	(.041)	(.034)
Log sales	.006***	.009***	.022***	-.556***	-.508***	-.340***
	(.001)	(.003)	(.005)	(.009)	(.018)	(.040)
Year effects	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y
Executive effects	N	N	Y	N	N	Y
Obs.	21,750	21,750	21,750	21,750	21,750	21,750
Adj. R²		.211	.815		.344	.859

The dependent variable in Models (1) to (3) is the scaled value of delta (*ScaledDelta*) where delta is scaled by annual compensation. The dependent variable in Models (4) to (6) is the Jensen and Murphy (1990) measure of PPS (*JM*) which captures the sensitivity of managerial wealth to a $1,000 increase in shareholder wealth. All other variables are similar to those defined in Table 2. Robust standard errors that are clustered by executive are presented in parentheses under the coefficients. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

TABLE 7
Robustness Tests

Panel B: Alternative measures of stock liquidity

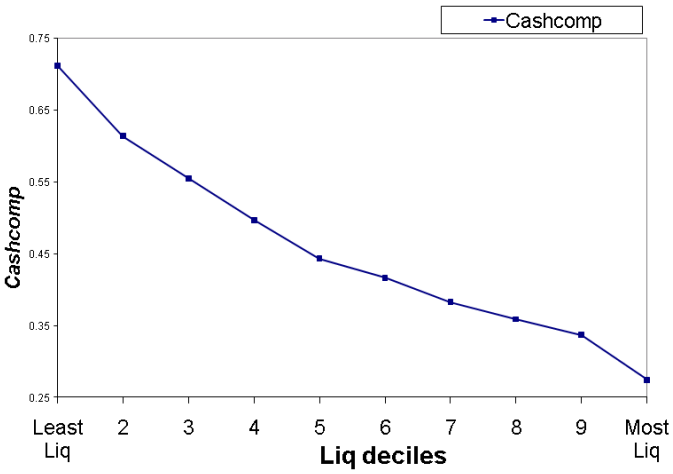
	Cashcomp			*LnDelta*		
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	.979***	.974***	1.132***	3.855***	4.473***	3.327**
	(.066)	(.075)	(.164)	(.389)	(.855)	(1.625)
LiqPC	-.146***	-.111***	-.061***	.872***	.882***	.676***
	(.005)	(.007)	(.010)	(.032)	(.053)	(.046)
Tobin's Q	-.023***	-.015***	-.014***	.282***	.274***	.170***
	(.002)	(.003)	(.004)	(.012)	(.018)	(.013)
ROA	.305***	.274***	.066	.881***	1.026***	.853***
	(.029)	(.036)	(.043)	(.170)	(.202)	(.136)
CFO	.052*	.019	-.038	-.197	-.269	.141
	(.027)	(.033)	(.038)	(.161)	(.203)	(.128)
Stock return	.027***	.015***	.019***	.333***	.357***	.324***
	(.004)	(.005)	(.005)	(.026)	(.024)	(.018)
ROA volatility	-.237***	-.239***	-.096	-.339	-.594*	-.202
	(.044)	(.056)	(.082)	(.257)	(.356)	(.326)
CFO volatility	-.154***	-.056	-.087	1.660***	1.649***	.804**
	(.051)	(.069)	(.093)	(.299)	(.464)	(.348)
Stock return volatility	-.051***	-.031***	-.031***	.241***	.242***	.118***
	(.005)	(.007)	(.011)	(.030)	(.042)	(.038)
Log sales	-.030***	-.030***	-.011	.137***	.161***	.239***
	(.002)	(.003)	(.009)	(.012)	(.021)	(.037)
Year effects	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y
Executive effects	N	N	Y	N	N	Y
Obs.	20,808	20,808	20,808	20,808	20,808	20,808
Adj. R²		.216	.457		.357	.842

The dependent variable in Models (1) to (3) is Cashcomp which denotes the proportion of cash-based compensation to total annual compensation while that in Models (4) to (6) is LnDelta which represents the log of the CEO's delta. LiqPC indicates the composite measure of stock liquidity computed by combining three measures - the relative bid-ask spread, the Amihud (2002) measure of illiquidity and the percentage of zero-returns of Lesmond et al. (1999) using principal components. LiqPC has been multiplied by minus 1 so that larger values indicate greater stock liquidity. All other variables are similar to those defined in Table 2. Robust standard errors that are clustered by executive are presented in parentheses under the coefficients. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Figure 1: Cash-based compensation (*Cashcomp*) and *PPS* across stock liquidity (*Liq*) deciles

Cashcomp is the ratio of cash-based compensation to total compensation. *Liq* is stock liquidity while Delta represents sensitivity of managerial wealth to 1% change in the stock price.

Panel A: *Cashcomp*



Panel B: *Delta*

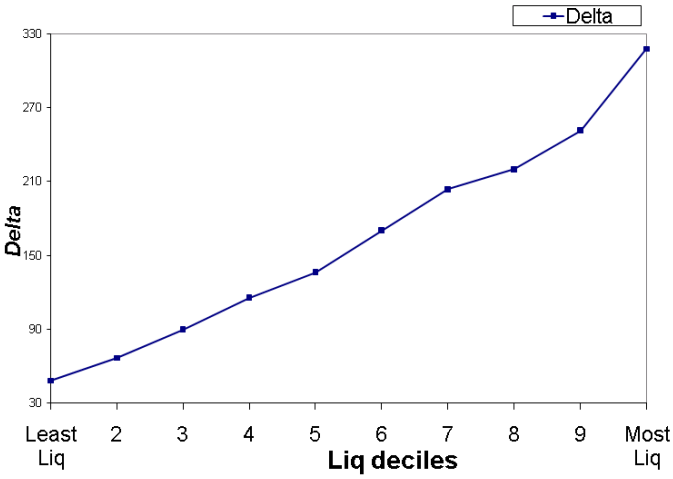
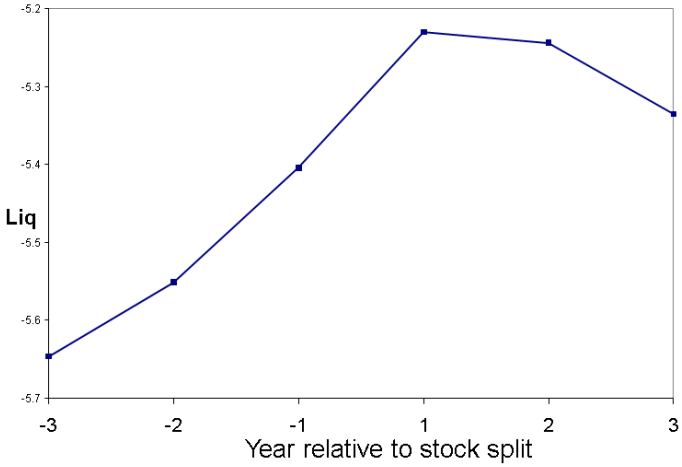


Figure 2: Change in stock liquidity and executive compensation around stock splits

Panel A: ***Liq***



Panel B: ***Cashcomp*** **and** ***LnDelta***