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GROWTH THROUGH RIGIDITY:
AN EXPLANATION FOR THE RISE IN CEO PAY

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ABSTRACT

The dramatic rise in CEO compensation during the 1990s and early 2000s is a longstanding puzzle. In this paper, we show that much of the rise can be explained by a tendency of firms to grant the same number of options each year. Number-rigidity implies that the grant-date value of option awards will grow with firm equity returns, which were very high on average during the tech boom. Further, other forms of CEO compensation did not adjust to offset the dramatic growth in the value of option pay. Number-rigidity in options can also explain the increased dispersion in pay, the difference in growth between the US and other countries, and the increased correlation between pay and firm-specific equity returns. We present evidence that number-rigidity arose from a lack of sophistication about option valuation that is akin to money illusion. We show that regulatory changes requiring transparent expensing of the grant-date value of options led to a decline in number-rigidity and helps explain why executive pay increased less with equity returns during the housing boom in the mid-2000s.

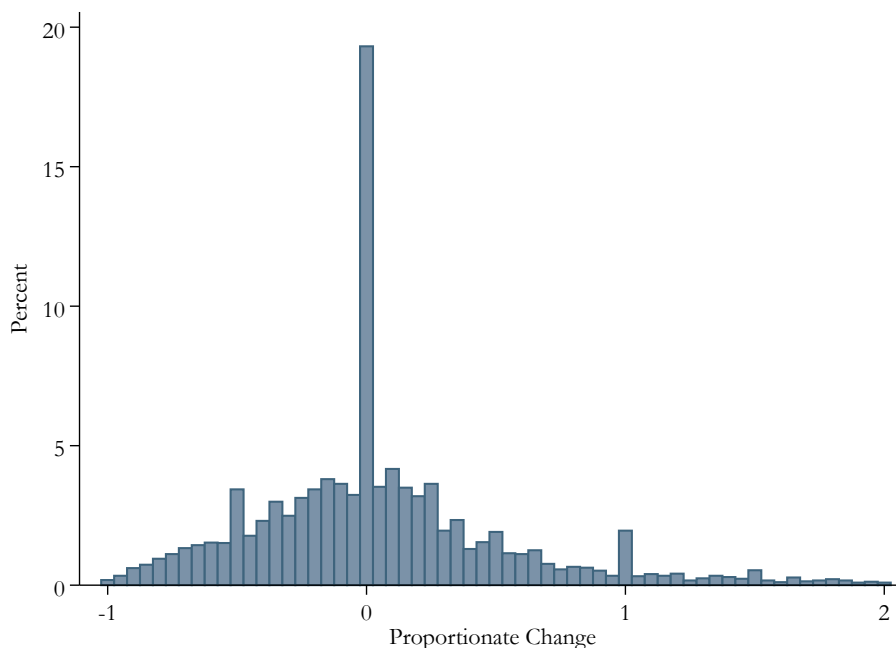
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A data appendix is available at <http://www.nber.org/data-appendix/w21975>

Figure 1

This figure shows the distribution of the proportional change in the number of options granted in the current year relative to the previous year. The sample is limited to CEOs who receive options in the current and previous year at firms that were ever a part of the S&P 500 from 1992 to 2010.



1. Introduction

The dramatic rise in compensation awarded to CEOs in the United States during the 1990s and early 2000s is a longstanding puzzle. Median compensation in 2011 dollars for S&P 500 CEOs grew more than threefold from \$2.9M in 1992 to \$9.3M in 2001. After the mid-2000s, growth leveled off considerably, with the median CEO earning \$9M in 2011 (Murphy, 2013). Compensation for US CEOs was also relatively flat in the decades leading up to the 1990s (Frydman and Saks, 2010). Thus, the compensation growth during the 1990s and early 2000s was a sharp break from both the trend established in preceding years and that which prevailed in subsequent years. Adding to the puzzle, the growth in CEO pay was also considerably off-trend relative to growth in other high-income occupations (Kaplan and Rauh, 2010; Kaplan, 2012).

A number of explanations have been proposed for the rise in CEO pay, including weak corporate governance (Bebchuk and Fried, 2004; Kuhnen and Zwiebel, 2009), an increase in managers'

marginal product due to technological advancement (Garicano and Rossi-Hansberg, 2006; Hubbard and Palia, 1995; Cuñat and Guadalupe, 2009a,b; Dow and Raposo, 2005), greater competition for CEOs with general skills (Murphy and Zábojník, 2004; Frydman, 2007), and increases in firm size combined with a multiplicative managerial production function (Gabaix and Landier, 2008; Tervio, 2008). While all these theories are likely to be important contributors to growth in executive compensation, each also has shortcomings in explaining some of the stylized facts (Frydman and Jenter, 2010), particularly the off-trend growth of CEO pay during the 1990s and early 2000s, hereafter referred to as the tech boom.

In this paper, we explore an alternative and complementary explanation for the surge in executive compensation. It is well known that the bulk of the growth in CEO pay arrived in the form of new at-the-money option grants. While much of the existing research focuses on the rising grant-date *value* of these options, we instead start by examining the *number* of options awarded to executives. We show that there is a high degree of rigidity in the number of options awarded. That is, firms often grant executives the exact same number of options as in the previous year. In addition, other round multiples of the previous year's number are common. These patterns suggest a tendency to think of option compensation in number rather than dollar terms. Such a tendency is also consistent with the fact that many firms use multi-year option plans, which pre-specify that the same number of options be granted in consecutive years (Hall, 1999; Shue and Townsend, 2014). Pre-planned or not, rigidity in number can have major implications for the level of CEO pay.

In particular, if a firm grants its CEO the same number of new at-the-money options as in the previous year, and if the firm's stock price is $X\%$ higher than in the previous year, the grant-date value of the option award will also be $X\%$ higher than in the previous year. This fact follows directly from the Black–Scholes formula. Thus, in an environment like the tech boom with rapid growth in stock prices, number-rigidity leads to rapid growth in the grant-date value of option pay.

Our analysis builds on insights from two comprehensive review articles on executive compensation by Murphy (1999; 2013). Murphy shows a near-perfect historical correlation between average executive pay and the S&P 500 index in the 1990s and early 2000s. He notes that such a pattern

would be consistent with compensation committees focusing on the number of options granted rather than the value of options granted. In this paper, we extend Murphy’s insights by first providing direct evidence that option grants over our sample period are indeed strongly rigid in number. As shown in Fig. 1, we find that nearly 20% of new grants contain the same number of options as the previous year’s grant. More broadly, the number change distribution suggests that executives and/or firms think about options in number rather than dollar terms. Even after adjusting for splits, there are also pronounced spikes at round multiples of the previous year’s number, such as double or half. Number increases of exactly 10%, 20%, and so on are also common.

Next, we show that number-rigidity leads to outsized growth in option pay when a firm’s stock returns are high. Specifically, we compare pay growth for similarly performing executives with and without number-rigid option pay. Consistent with the above discussion of the Black–Scholes formula, we find that the slope of the relation between changes in the grant-date value of option awards and a firm’s stock return is approximately one when grants are number-rigid. This relation is significantly less steep for executives with non-number-rigid (henceforth, non-rigid) option pay. Thus, CEOs with number-rigid grants gain more than CEOs with non-rigid grants when firm returns are high. Given that the tech boom was a period of extremely high stock returns, number-rigidity contributed to the concurrent high growth in CEO option pay.

Even if number-rigidity leads to growth in the value of options granted, it remains possible that other forms of compensation decrease when returns are high in order to keep total compensation in line. However, we find no evidence of cash or other forms of compensation offsetting any of the increase in option compensation caused by number-rigidity. If anything, other forms of compensation actually appear to reinforce the outsized growth in option pay.

It is also important to recognize that CEOs receiving non-rigid option pay may still experience higher pay growth than they would have absent number-rigidity among their peers. This is because competition for CEO talent among firms should lead to spillovers in compensation. To investigate whether such spillovers operate in our context, we examine whether executives with non-rigid option pay tend to have higher compensation growth when more of their peers are number-rigid and have

experienced recent high returns. We find that this is indeed the case, consistent with compensation spillovers from number-rigid to non-rigid executives.

Given the above findings that 1) number-rigidity is prevalent, 2) it leads to outsized option pay growth when returns are high, 3) other forms of compensation do not decrease to offset this option pay growth, and 4) there are spillovers onto non-rigid executives, it seems quite plausible that number-rigidity could account for a significant portion of overall growth in CEO pay during the 1990s and early 2000s. To give a sense of potential magnitudes, we calibrate an equilibrium model of CEO pay. Our calibrations show that, under a wide range of parameter assumptions, number-rigid option compensation can explain more than half of the off-trend growth in CEO pay during the tech boom.

A number-rigidity-based explanation for the rise in CEO pay also matches three other stylized facts. First, not only did the level of CEO pay increase during the 1990s and early 2000s, but so did the cross-sectional dispersion of CEO pay (Frydman and Jenter, 2010). This increase in dispersion is a natural consequence of number-rigidity, which increases the sensitivity of compensation to the highly idiosyncratic returns of individual firms. Second, non-US CEOs experienced significantly slower compensation growth during the tech boom, controlling for country-level growth and firm characteristics (Abowd and Bognanno, 1999; Abowd and Kaplan, 1999; Murphy, 1999; Thomas, 2009; Fernandes et al., 2013). Equity-based compensation is also less common for non-US CEOs, often for regulatory reasons. For example, option plans were illegal in Germany until 1996. As a result, non-US executives are less likely to have a number-rigid component of their pay. Finally, our explanation is consistent with the empirical fact that compensation became very correlated with firm-specific stock returns in the 1990s.

In the remainder of the paper, we explore the question of why there is number-rigidity in option pay. In particular, we attempt to distinguish empirically between two broad classes of theories. The first class consists of theories in which all parties involved understand how to value options and choose to hold the number granted fixed because number-rigidity implements an optimal incentive scheme. For example, firms may grant number-rigid options to manage executive ownership or to

award steep pay-for-performance incentives.

The second broad class of theories includes explanations in which at least one party in the compensation-setting process is somewhat unsophisticated about how to value options. Given that options are typically granted at-the-money, it is not immediately obvious that granting the same number of new options after a stock price increase would coincide with a pay increase. Fully understanding this notion requires knowledge of option pricing formulas that economists only derived relatively recently (Black and Scholes, 1973). There is ample anecdotal evidence that when option compensation first came into widespread use, many did not understand or trust these formulas. Instead, number may have been used as a proxy for value. This heuristic is similar to thinking about money in nominal rather than real terms, i.e., money illusion (Kahneman et al., 1986; Shafir et al., 1997). Further, prior to 2006, government regulations concerning the reporting of options focused on number rather than value. These regulations likely reflect, but also may have influenced, the way that option compensation was commonly measured.

We find a number of results pointing toward the second class of theories. We begin by testing whether firms become less likely to grant number-rigid options when they are required to disclose or expense the grant-date dollar value of those options on their proxy and income statements, respectively. If number-rigidity implements an optimal contract, the contract should remain optimal regardless of the way option compensation is reported to shareholders. However, if number-rigidity arises from naïveté on someone’s part, changes in reporting requirements may reduce that naïveté.

To examine these issues, we exploit two separate reforms by FASB and the SEC that went into effect in 2006. The FASB reform required firms to expense on their income statements the total Black–Scholes value of option compensation paid to employees. The SEC reform required firms to disclose the Black–Scholes value of option compensation paid to each top executives on their proxy statements. We find that, following these two reforms, the prevalence of option number-rigidity (conditional on granting options) declines significantly. To control for concurrent time trends, we use a differences-in-differences framework with stock compensation as a control group. Stock compensation also has a number and value associated with it, but its value had to be expensed and

disclosed throughout our sample period. We find no change in number-rigidity for stock compensation and a large decline in number-rigidity for option compensation. Moreover, we find that prior to the reforms, the prevalence of number-rigidity was much higher for option compensation than stock compensation. The latter finding is consistent with the idea that converting number to value is harder for options than for stock, leading to greater money-illusion type thinking.

The above analysis of regulatory changes suggests that some combination of expensing and disclosure reduces number-rigidity in option pay. An important remaining question is whether it is primarily expensing or disclosure that is responsible for the reduction. Given that the FASB and SEC reforms so closely coincided, it is difficult to distinguish the two empirically. We instead exploit the fact that, prior to the reforms, some firms voluntarily chose to expense and/or disclose. Using hand collected data from 10-K filings, we find that firms that voluntarily expensed the Black–Scholes value of their option compensation were significantly less likely to use number-rigid option awards (both within and between firms). In contrast, firms that voluntarily disclosed the Black–Scholes value of their option compensation were no less likely to use number-rigid option awards. These findings suggest that subtracting the total value of option compensation from reported earnings (i.e., expensing) has a greater effect on how the cost of option awards is viewed than merely reporting the value of option awards paid to high-ranking executives (i.e., disclosure).

In addition, it is plausible that firms with more independent or sophisticated boards are more likely to choose optimal compensation structures or to be aware of option valuation methods. We find that boards with a greater percentage of independent directors, directors that joined before the current CEO, or directors with an MBA degree are significantly less likely to grant number-rigid options. These findings cut against the first class of theories, in which number-rigidity arises from optimal contracting.

Given that transparent reporting requirements and board independence/sophistication reduce number-rigidity, one may wonder whether sophisticated CEOs consciously use number-rigidity to conceal high compensation growth from less sophisticated boards or shareholders. Here, we find mixed evidence. On the one hand, we find that the probability of receiving number-rigid grants

is asymmetric with respect to firm returns. The probability of a CEO receiving number-rigid pay following extreme positive returns (when they benefit the most from rigidity) is considerably higher than the probability following extreme negative returns (when they suffer the most from rigidity). This asymmetry suggests that at least some CEOs recognize that the value of the same number of new options varies with their firm's stock price. However, we also find results suggesting that some CEOs think about option compensation in units of number, or at least endure large losses in value due to number-rigidity. In particular, we find that following a positive stock split, many CEOs continue to receive the same, non-split-adjusted number of options as in the previous year. Rigidity of this type represents a large decline in CEO pay. In contrast, following a split, very few executives receive the same, non-split-adjusted number of shares of stock as they did in the previous year. This is again likely because it is much easier to convert number to value for stock than options.

Overall, we show that number-rigidity helps explain many of the striking stylized facts relating to CEO pay during the tech boom period. Our analysis also offers a potential explanation for why CEO pay growth tapered considerably after the tech boom, despite high stock market returns during the housing boom of the mid-2000s. We show that firms shifted their focus from number to value during this period, partly due to regulatory changes requiring the expensing of the grant-date value of option awards.

2. Recent Trends in Executive Compensation

2.1. *Growth in Executive Compensation*

Before exploring the effects of rigidity on compensation growth, we first review recent trends in executive compensation. Fig. 2 shows how CEO compensation evolved from 1992 to 2010, estimated following the method used by Murphy (2013). We restrict the sample to CEOs of firms that were ever a part of the S&P 500 during the sample period. There are 947 such firms. The level of each bar represents the median level of total compensation in each year in 2011 dollars. Each bar is decomposed based upon the mean proportion of each component of compensation in each year. As

has been previously documented, total compensation more than tripled from 1992 to 2001, before subsequently leveling off. As can also be seen, the vast majority of this growth was in the form of option compensation, which came to represent the largest component of CEO pay. Most of the other components remained relatively flat during this time period. In later years, option compensation appears to have been partly replaced by stock compensation. The decline in option compensation most likely occurred because firms were required to begin expensing the grant-date fair value of options in the mid-2000s, which reduced the accounting advantages of option grants.

Note that compensation in Fig. 2 is reported in terms of grant-date value instead of realized value at exercise. Therefore, the growth in compensation cannot be attributed to the fact that previously granted options and restricted stock are worth more at exercise following strong equity returns. Instead, the figure shows that the grant-date value of new option awards each year grew dramatically in the 1990s and early 2000s.

Fig. 3 shows the time series of median option compensation, non-option compensation, and total compensation for the same sample as Fig. 2. Income for the top 1% and 0.1% of US earners from Piketty and Saez (2003) are also shown for comparison. All values are adjusted for inflation and normalized to equal one in 1992. This figure shows that CEO option compensation grew much faster than other forms of CEO pay from 1992 to 2001. Option compensation grew more than sixfold over this period, while non-option compensation remained relatively flat, growing at a rate similar to income for the top 1% and 0.1% of earners. Thus, most of the growth in total CEO compensation in excess of other high earners during this period came in the form of options. Also consistent with Fig. 2, total compensation leveled off considerably after 2001, while option compensation decreased, and non-option compensation increased.

Finally, growth rates of CEO and top executive compensation in the US greatly outpaced growth rates in other countries during the tech boom. This abnormal growth remains after controlling for country-level economic growth and firm characteristics (Abowd and Bognanno, 1999; Abowd and Kaplan, 1999; Murphy, 1999; Thomas, 2009; Fernandes et al., 2013). In addition, Frydman and Jenter (2010) note that the cross-sectional dispersion in CEO pay rose dramatically during the tech

boom, a finding that we corroborate using our data in Fig. A1 in the Online Appendix .

2.2. Regulatory Changes and the Use of Options

In this paper, we show that rigidity in the number of options granted, combined with rapidly increasing equity prices and lack of offsetting changes in other forms of compensation, can help explain the patterns just described. We acknowledge that this is somewhat of a partial theory in that it does not explain why option compensation came into use in the first place. Murphy (2013) argues that the sudden rise in the use of options as a form of compensation for executives in the 1990s was driven by a “perfect storm” of increased shareholder pressure for equity-based pay combined with various regulatory changes that happened to coincide.

For example, in 1991, the SEC changed its holding period rules so that stock acquired from exercising options could be sold immediately, as long as the exercise date was more than six months after the grant date. Prior to the rule change, executives had to hold stock acquired from exercising options for at least six months. This requirement meant that executives exercising options had to deal with cash-flow issues (from paying the exercise price) and risk (from the possibility that the stock price might decline between the time the options were exercised and the shares obtained were sold). In 1992, the SEC set pay disclosure rules such that only the number of options paid to executives needed to be disclosed and not the value of those options. In 1993, the Clinton \$1M deductibility cap was passed. This cap made compensation in excess of \$1M non-deductible for tax purposes. However, the cap did not apply to performance-based pay, including at-the-money options. In addition, prior to 2006, options did not need to be recognized as an expense on a firm’s income statement, making them attractive from an accounting perspective.

Again, we do not attempt to explain why firms began using options. The above factors all likely contributed. Our goal is to show that, conditional on using option compensation, a focus on the number of options awarded led to high growth in the grant-date value of new awards.

2.3. Existing Explanations

A number of theories have been proposed for the growth in US CEO compensation in recent decades. One view is that CEOs were able to raise their own pay due to weak corporate governance (Bebchuk and Fried, 2004; Kuhnen and Zwiebel, 2009). However, there is little evidence that corporate governance has become weaker over time or in the 1990s in particular. If anything, it appears that governance has been on an upward trend (Holmstrom and Kaplan, 2001; Hermalin, 2005; Kaplan, 2008). More in the spirit of this paper, it has also been argued that options may have been difficult for boards or shareholders to understand (Hall and Murphy, 2003; Jensen et al., 2004), and thus were an easier form of compensation for executives to “skim.” In later analysis, we show that lack of sophistication with respect to option valuation may have contributed to number-rigidity and that firms with more independent or sophisticated boards were less likely to grant number-rigid pay.

A second view is that the growth in CEO pay is primarily due to increases in firm size. According to this view, managerial talent has a multiplicative effect on firm output, so matching with a slightly more talented manager can lead to large increases in firm value (Gabaix and Landier, 2008; Tervio, 2008). Gabaix and Landier show that, under certain conditions, CEO pay should move one-for-one with changes in the size of the typical firm. Thus, the sixfold increase in CEO pay between 1980 and 2003 can be explained by the sixfold increase in average market capitalization over that period. However, Frydman and Saks (2010) show that there is virtually no correlation between firm size and CEO pay prior to 1970. In a similar vein, Nagel (2010) shows that the relation following 1970 is sensitive to sample-selection. More generally, we believe Gabaix and Landier’s model highlights a very important channel for the growth in executive compensation. However, for the growth in firm size to explain *all* of the rise in CEO compensation in recent decades, one must make strong parameter assumptions. We show that number-rigidity can help explain the off-trend growth in CEO compensation during the tech boom while allowing for more conservative assumptions.

A third view is that CEO compensation has risen due to changes in the nature of the job. For example, managers’ marginal product may have increased due to improved communications

technology (Garicano and Rossi-Hansberg, 2006), increased competition (Hubbard and Palia, 1995; Cuñat and Guadalupe, 2009a,b), or higher volatility of the business environment (Dow and Raposo, 2005; Campbell et al., 2001). Hermalin (2005) suggests that CEOs must be compensated for the increased risk of being fired due to improved corporate governance. Frydman (2007) and Murphy and Zabojnik (2010) show that CEO jobs have increasingly placed a greater emphasis on general rather than firm-specific skills; this shift may have allowed managers to capture a greater portion of the rents.

While all these theories are likely to be important contributors to the growth in executive compensation over the past several decades, they also do not fully capture the unique trends during the tech boom (Frydman and Jenter, 2010). None of these theories are tied directly to option compensation, and they do not account for the increase in the cross-sectional dispersion of CEO pay. In addition, the effect of the various factors suggested may not be large or rapid enough to explain the dramatic off-trend growth in compensation during the 1990s and early 2000s.

Related to this paper, Murphy (2002) argues that misperceptions regarding the cost of option compensation may have contributed to compensation growth. He argues that many boards and practitioners viewed the cost of granting options as far below the true economic cost because options could be granted with no cash outlay, without incurring an accounting charge, and upon exercise led to no change in accounting income as well as a reduction in taxable income. The number-rigidity phenomenon highlighted in this paper may be symptomatic of a related form of misperceived costs in which number is taken as a proxy for value. Consistent with the idea that firms misperceive costs if they are not accompanied by changes to recognized accounting income, we show in Section 5.2 that firms were less likely to focus on the number of options granted if they expensed the Black–Scholes value of options when reporting earnings.

3. Data

3.1. Sources

We use executive compensation data from Execucomp, which covers firms in the S&P 1500. Our sample period runs from 1992 to 2010. The data are derived from firms' annual proxy statements and contain information regarding the compensation paid to the top executives in a firm (usually five per firm) in various forms (e.g., salary, bonus, stock, options, etc.) during the fiscal year. For options, Execucomp contains detailed grant-level data on the date, number, and value of each option grant. In 20% of cases, executives receive more than one option grant during a fiscal year. Often, one grant is specific to the executive, while another is part of a long-term incentive plan that is common among all executives in the firm. In these cases, we focus on the largest option grant (as measured by the number of options) within each fiscal year, to better identify number-rigid grants.

For observations after 2006, we use the exact date of the option grant to precisely measure firm returns between consecutive grants. Prior to 2006, firms were only required to report the expiration date of the option grant. Following the literature (e.g., Aboody and Kasznik, 2000; Lie, 2005), we infer the grant date from the expiration date under the assumption that expiration dates occur on grant date annual anniversaries. However, we note that this may introduce error into our estimates of firm returns between consecutive grants as some firms set expiration dates to the end of quarters or years. In order to properly split-adjust the grant-level data, we assume that, following SEC requirements, firms do not report the number of options originally in a grant, but the number of options in a grant as of the proxy date (SRCDATE in Execucomp). Thus, if an executive was granted 100 options, but there was a 2-for-1 stock split prior to the proxy date, the firm would report that the executive was granted 200 options on its proxy statement. We verify that our results are not driven by reporting errors around splits, as discussed in Section C in the Online Appendix . Finally, firms were required to begin reporting the fair value of option compensation in 2006. Following the literature, we use the Black–Scholes value computed by Execucomp prior to

2006.

Execucomp offers grant-level option award data throughout our sample period. However, it only has grant-level stock award data after 2006. Therefore, we instead use grant-level stock award data from the Form 4 filings that the SEC requires of CEOs and other insiders. These filings must report details of changes in ownership—including from stock grants. Thomson-Reuters collects this information in their TNF Insider Filings dataset.¹ We merge these data based on CEO names, hand matching in ambiguous cases.

We hand collect data on voluntary expensing of option compensation from firms' 10-K filings. Data on board characteristics come from RiskMetrics. Director education information comes from BoardEx. Accounting data come from Compustat. Market and firm return data come from the Center for Research in Security Prices (CRSP) and the Fama–French Data Library. For all our analysis, unless otherwise noted, we restrict the sample to CEOs of S&P 500 firms. Because firms may enter and exit the S&P 500 during our sample period, we include all 947 firms that were ever part of the S&P 500 during the sample period. This assures that the trends we document do not merely reflect changes in the composition of the index.

Our baseline analysis focuses on S&P 500 CEOs because they experienced the most dramatic and publicly scrutinized increases in pay. However, other top executives also experienced strong pay growth during our sample period. In supplementary results shown in Fig. A2 in the Online Appendix, we also find strong number-rigidity in extended samples using all top executives in a firm and/or all firms in the S&P 1500. This suggests that number-rigidity can account for increases in executive compensation more broadly. To increase estimation power, we use these extended samples in some regressions.

¹A limitation of these data is that restricted stock units that are convertible into shares upon vesting might not be reported on a Form 4 until they vest. However, these units would still show up as “value” in the compensation summary table of the proxy statement.

3.2. Identifying Number-Rigid Grants

We categorize option grants each year as number-rigid if the split-adjusted number of options in the grant is the same as in the previous year. More broadly, we categorize grants as number-reference (inclusive of number-rigid) if the ratio of the number of options granted in the current year relative to the previous year equals $1 \pm$ a multiple of $1/2, 1/4, \dots, 1/10$. Number-reference grants may award exactly double or half the number of options awarded in the previous year, or they may award other exact fractional increases/decreases. These number-reference grants could reflect a focus on number in the compensation-setting process, however, in some cases they may be an artifact of rounding to the nearest round lot in number. Observations in which the executive received zero options in either the current or previous year are never categorized as number-rigid or number-reference (e.g., receiving zero options in two consecutive years is not considered number-rigid). We also only compare the number of options in consecutive years (e.g., a CEO who receives 100,000 options in 1996, none in 1997, and 100,000 in 1998 would not be considered number-rigid in either 1997 or 1998).

In later parts of this paper, we also refer to “number-rigid firms.” By number-rigid firms, we mean firms that granted number-rigid options to their CEO in the current year. A firm does not necessarily grant the same number of options to its CEO for the full length of his or her tenure. However, we find that when a formerly number-rigid firm does adjust the number of options granted, the CEO usually receives an increase in option compensation (both in terms of number and value), as shown in Table A2 in the Online Appendix .

3.3. Summary Statistics

Next, we explore the extent to which firms with number-rigid CEO option compensation differ from other firms in terms of their observable characteristics. Because there are likely to be time trends in these variables and the prevalence of number-rigidity has changed over time, we examine three cross-sections of the data from 1995, 2000, and 2005 rather than pool all years together. Table 1

compares firm characteristics for number-rigid, number-reference, and other option paying firms. Number-rigid and number-reference firms appear to be fairly similar to other option payers in terms of size, market to book, investment, leverage, and profitability. We also find that number-rigidity occurs across many industries and that the overall industry distribution is fairly similar for the three types of firms (see the Online Appendix for details). However, our analysis does not assume that firms choose to grant number-rigid compensation randomly. Indeed, firms that do so may choose to report information in a less transparent manner or have worse proxies for governance, as shown in our later analysis.

4. Results

4.1. *Rigidity in Executive Compensation*

We begin by exploring the extent of rigidity in various units of executive option and stock grants over our sample period. By rigidity, we refer specifically to cases in which the compensation growth distribution appears lumpy, with extra mass at zero (no change relative to the previous year). First, we compute the percent change in the (split-adjusted) number of options granted to a CEO in the current year relative to the previous year. Panel A of Fig. 1 shows a histogram representing the distribution of growth in the number of options awarded to a CEO. The sample consists of CEOs that received options in the current and previous year. The most striking feature of this figure is the large spike at zero. By far, the modal outcome is for a CEO to be paid the exact same number of options in the current year as in the previous year. This is the case for nearly 20% of CEO option grants. Interestingly, there are also spikes at round changes such as -50% and 100%, even after adjusting for splits. In addition, we find that many other changes occur in round units—for example, an exact 10% increase in the number of options awarded relative to the previous year. These patterns would seem to suggest that someone in the compensation-setting process thinks of option grants in number rather than dollar terms.

We focus on number-rigid grants in this paper because they represent a common and easily

identifiable compensation policy in the data. However, some firms may also have focused on number in other ways. For example, they may have rewarded CEOs for high firm returns with (potentially non-round) increases in the number of options. It is difficult to necessarily categorize number increases coupled with high returns as representing number-focus, but such behavior would only increase compensation growth. For reasons that will become clear in the next section, a number increase following high returns would lead to a particularly large increase in the value of option pay. In Fig. A3 in the Online Appendix we show that, conditional on returns over 25%, there were indeed many firms during the tech boom that still increased the number of options granted.

To further explore the extent to which option grants reflect a focus on number or value, we also examine the distribution of growth in the grant-date Black–Scholes value of options awarded to a CEO. Panel A of Fig. 4 shows this distribution. We find weaker evidence of rigidity in terms of Black-Scholes value: less than 6% of CEOs receive the same value of options as in the previous year.²

Next, we examine stock compensation. In Fig. 4, we plot the growth distribution for the number and value for shares awarded to a CEO. The value of a stock grant may be easier to conceptualize than the value of an option grant. Therefore, one might expect executives and boards to be more likely to think about stock compensation in dollar terms, leading to less number-rigidity. This is exactly what we find. Stock grants are somewhat rigid in number, but to a significantly lesser extent than options.

4.2. *Option Number-Rigidity and Option Pay Growth*

Next, we explore the implications of number-rigidity for option pay growth when stock returns are high. As mentioned earlier, if a firm grants its CEO the same number of new at-the-money options

²We also find evidence that other firms focused on value by granting constant value as a multiple of salary or constant face value (defined as the grant date price of the underlying multiplied by the number of options) in consecutive years, with large value increases awarded every several years. We argue that all firms, even if they were value-focused, experienced competitive spillover effects from number-focused firms in terms of growth in compensation during the tech boom. In addition, prior to 2006, firms were not required to disclose the Black–Scholes value of options paid to top executives. Therefore, we use the Black–Scholes value computed by Execucomp for the earlier years of the sample. We do not find major differences in value-rigidity when value is self-reported or computed by Execucomp.

as in the previous year, and the firm’s stock price is $X\%$ higher than in the previous year, the grant-date value of the option award will also be $X\%$ higher than in the previous year. This follows directly from the Black–Scholes formula. In particular, for an at-the-money option with a strike price X that is equal to the grant-date stock price S , the Black–Scholes formula reduces to:

$$S * [e^{-dT} N(Z) - e^{-rT} N(Z - \sigma T^{(1/2)})],$$

where $Z = [T(r - d + \frac{\sigma}{2})]/\sigma T^{(1/2)}$. From the formula, it is clear that doubling S will double the value of the option. To gain further intuition, consider what occurs in a reverse stock split, where two shares become one share and the stock price doubles. In this case, two options also become one. Thus, two at-the-money options on the old stock must be worth the same as one at-the-money option on the new stock. In other words, when the stock price doubles in the split, the value of an at-the-money option must double as well.

In light of the discussion above, we compare the relation between option compensation growth and firm returns for the number-rigid and non-rigid samples. For this exercise, we exclude number-reference grants from the non-rigid sample. This is done because it is unclear whether number-reference grants reflect a focus on number, and we want to form a counterfactual based on grants that are less likely to be number-focused.³ Fig. 5 plots changes in the log Black–Scholes value of options granted against the log firm return between two consecutive grants. The sample consists of CEOs that received options in the current and previous year. We fit a local linear regression using the Epanichnikov kernel with the rule-of-thumb bandwidth. Absent any changes in volatility or other parameters in the Black–Scholes formula, we expect the relation within the number-rigid sample to fall along the 45 degree line. Because these parameters do not change substantially year to year within our sample, we indeed find that the empirical relation falls very close to the 45 degree line. However, for non-rigid grants, we find that the relation between option value growth and firm

³Nonetheless, our results change little if number-reference grants are included in the non-rigid sample. Likewise, we find similar results if we exclude firms that granted number-rigid options in the previous year (but not in current year) from the non-rigid sample.

returns is substantially flatter. The two curves cross just to the right of zero. Thus, CEOs with number-rigid grants gain more than others when firm returns are positive. Consequently, during boom periods when firm returns are high on average, CEOs with number-rigid grants experience higher option pay growth than others with similar performance.

4.3. Lack of Offsets in Other Forms of Compensation

Next, we explore the extent to which changes in cash and other non-option compensation offset changes in the value of option grants for number-rigid CEOs. In times when option pay growth for number-rigid CEOs is very high due to high firm returns, boards could presumably counteract the change in option pay by adjusting cash compensation in the opposite direction. This would allow firms to follow a number-rigid policy while simultaneously moderating changes in total pay when returns are extreme. However, Fig. 2 suggests that there was not a broad reduction in other forms of pay as options exploded during the tech boom. Indeed, for many firms, there are not enough dollars in these other forms of pay to offset the large increase in grant-date option values.

To more formally examine the question of whether other forms of compensation decline to offset increases in option pay induced by number-rigidity, we reproduce Fig. 5 with the y-axis now representing cash compensation (salary plus bonus). The results are shown in Panel A of Fig. 6. If cash compensation offsets rigidity-driven changes in option pay, we would expect to find a negatively sloped line. As can be seen, cash compensation does not decline for number-rigid CEOs as firm returns become increasingly positive; rather, it increases. Moreover, cash compensation increases similarly with firm returns for number-rigid CEOs and non-rigid CEOs. If anything, the slope is slightly steeper for number-rigid CEOs. In Panel B, we also examine all non-option compensation, including the grant-date value of stock awards. Again we find no evidence that non-option compensation decreases for number-rigid CEOs when returns are high.

Of course, risk-averse CEOs may value an additional dollar of risky option compensation less than a dollar of certain cash compensation. Thus, we would not necessarily expect cash or other non-option compensation to decline one-for-one with rigidity-induced increases in option pay. How-

ever, our findings suggest that non-option compensation does not decline at all. If anything, it appears that non-option compensation reinforces rather than offsets increases in option pay driven by number-rigidity.

4.4. *Spillovers*

It is also important to recognize that CEOs whose option compensation is not number-rigid may still experience higher pay growth than they would have absent number-rigidity among their peers. This is because competition for CEO talent among firms should lead to spillovers in compensation. Before presenting direct tests of spillovers, we first present three pieces of motivating evidence that spillovers between number-rigid and non-rigid firms are likely to occur. For brevity, we reserve detailed analysis for Table A2 in the Online Appendix and summarize the results below.

First, we find that firms that awarded number-rigid options to the previous CEO tend to award the same high compensation to new incoming CEOs. This suggests that the compensation levels at number-rigid firms will add competitive pressures to the market for CEO talent. Similarly, we find that number-rigid firms do not undo the gains in compensation experienced during number-rigid years when they do adjust the number of options granted. In fact, number-rigid firms actually tend to increase the value of compensation granted during flexible years as compared to a control sample of firms that did not grant number-rigid options in the previous year. Thus, number-rigid firms do not follow an “Ss-style model” in which they allow compensation to drift up with returns during rigid years and then implement a large adjustment downwards in value or number during flexible years. If firms followed an Ss-style model, number-rigidity might not exert upward pressure on the compensation of non-rigid peers, as gains from number-rigidity would be temporary. Finally, we find that executives at number-rigid and non-rigid firms appear to work in integrated rather than segmented labor markets. That is, executives working at number-rigid firms are no more likely than others to transition to another number-rigid firm. These results suggest that number-rigid and non-rigid firms compete for a common pool of executive talent.

While we have shown that conditions are conducive to spillovers in pay from number-rigid to non-

rigid firms, one may question whether such spillovers in value will occur. If firms and/or executives misperceive the value of options using number, then increases in the value of option pay at number-rigid firms would not necessarily apply upward pressure on non-rigid peers. However, in setting pay levels, most S&P 500 companies rely on private surveys from compensation consultants providing information on executive pay in similar firms in terms of size and industry. By the beginning of our sample period, most of these compensation consultants were using Black–Scholes to measure grant-date values. Thus, the surveys informing compensation committees about competitive pay levels were based on Black–Scholes and did not distinguish firms making number-rigid grants.

To directly investigate whether there are spillovers from number-rigid firms to non-rigid firms, we examine whether executives without number-rigid option pay tend to have higher compensation growth when more of their peers are number-rigid and have experienced high recent returns. Specifically, we match each CEO in our sample to CEOs of peer firms. Following Faulkender and Yang (2010), we define peer firms as firms in the same industry (2-digit SIC code) with sales between 50% and 200% of the CEO’s firm. We set the CEO’s compensation date as the date of the largest option grant from the fiscal year. For symmetry, when a CEO does not have an option grant in a fiscal year, we assign an artificial compensation date 270 days prior to the firm’s fiscal year end.⁴

For each CEO, we then define *Percent Peers Rigid* and *Percent Peers Reference* as the percent of peer CEOs (with compensation dates within the past 365 days) that had number-rigid or number-reference option grants, respectively. We also define *Peer Returns* as the average firm return of peer firms in the year leading up to each peer’s compensation date. If there are spillovers among peers, we should see that compensation growth for non-rigid CEOs is higher when more of their peers have number-rigid (or number-reference) grants and experience high returns leading up to the grant.

The results of this spillovers analysis are shown in Table 2. The dependent variable is the log change in total compensation. In Columns (1)–(3), the sample consists of all S&P 500 CEOs without a number-rigid option grant. In Columns (4)–(6), the sample consists of CEOs without a number-reference option grant. As can be seen, we find a significant positive interaction between peer

⁴For executives receiving options, 270 days is the median time between the date of their largest option grant and the end of the fiscal year.

returns and peer number focus across all samples and specifications, including with firm fixed effects in Columns (3) and (6). Thus, CEOs with non-rigid option pay experience stronger compensation growth when their peer group has more number-rigid option pay and higher returns. These results are consistent with spillovers, most likely operating through compensation surveys.

4.5. *Calibration Exercise*

Given the above findings that 1) number-rigidity is prevalent, 2) it leads to outsized option pay growth when returns are high, 3) other forms of compensation do not decrease to offset this option pay growth, and 4) there are spillovers onto non-rigid executives, it seems quite plausible that number-rigidity could account for a significant portion of overall growth in CEO pay during our sample period.

To give a sense of potential magnitudes, we calibrate a model of equilibrium compensation from Gabaix and Landier (2008) (henceforth, GL). It may appear counterintuitive to use the GL model to calibrate equilibrium effects of number-rigidity, as under certain parameter assumptions, the GL model can already explain the growth in compensation during the tech boom without option number-rigidity. However, for the growth in firm size to explain *all* of the rise in CEO compensation, one must assume that a key model parameter, γ , equals one. The parameter γ represents the impact of CEO skill on firm earnings. When γ equals one, this implies constant returns to scale. When γ is less than one, this implies decreasing returns to scale. GL show evidence that the assumption of γ being equal to one holds from 1992–2004. However, Frydman and Saks (2010) suggest that γ is much closer to zero prior to 1970. In a similar vein, Nagel (2010) shows that the relation following 1970 is sensitive to sample-selection. In our own untabulated results, we estimate γ equal to 0.48 in the years 2004–2013.

We stress that it is not the goal of this paper to claim that γ is less than one or that γ did not increase during the tech boom. However, we hope to offer a complementary explanation for the rise in compensation that is tied to an easily observable empirical pattern (number-rigidity in option compensation that arose only during the tech boom) and does not require assumptions about γ

being close to one. In what follows, we show that $\gamma = 0.5$ plus number-rigidity can explain the off-trend growth in CEO compensation during the tech boom.

GL's model implies that, if a fraction f of firms wish to pay their CEO λ as much as similarly sized firms, the pay of all CEOs will increase by

$$\Lambda = \left[f \left(\frac{(1-f)\lambda}{1-f\lambda} \right)^{1/(\alpha\gamma-\beta)} + 1 - f \right]^{\alpha\gamma}, \quad (1)$$

where γ represents the impact of CEO skill on firm earnings, α describes the distribution of firm size in the right tail (most estimates imply that $\alpha = 1$, see GL for a full explanation) and β is determined such that $\gamma - \frac{\beta}{\alpha}$ is equal to the relation between log compensation and log firm size (approximately 0.2 – 0.4 in the data, see GL for a full explanation). We set f equal to the fraction of number-rigid CEOs in each year of our data. Following GL, we focus on differences in the grant-date value of total pay between number-rigid and non-rigid firms (as shown earlier, these differences are primarily due to differences in the grant date-value of option pay and lack of offsets in non-option pay). We set λ equal to the average difference between actual and counterfactual total pay growth each year in the non-rigid sample, using realized returns for each firm and the relation estimated in Fig. A4 in the Online Appendix. For other model parameters, we use $\gamma = 0.5$, $\alpha = 1$, and $\beta = 0.3$.

Fig. 7 shows the calibration results. The solid line represents the median value of total compensation granted each year in the real data. The short-dashed line shows cumulative growth that can be attributed to number-rigid option grants including spillovers, assuming that growth absent number-rigidity would have been zero. We find that number-rigidity can explain more than half of the growth in median compensation during the tech boom and over the course of the full sample period from 1992 to 2010.

We also account for the additional changes in compensation implied by the GL model due to changes in firm size. The long-dashed line shows the cumulative growth in median compensation that can be attributed to a combination of number-rigidity and changes in median firm size.⁵ We

⁵The size of the typical firm in each year is calculated as the debt plus equity (Compustat codes: `prcc_f*abs(csho)+at-ceq-txdb`) of the 250th largest firm in each year, measured in 2000 dollars, following

find that number-rigidity combined with growth in aggregate firm size can approximately match all of the growth in compensation over the sample period.

Our estimates are meant to provide a rough guide for the potential magnitude of the effect of number-rigidity. In Table A3 in the Online Appendix , we estimate the effect using a range of alternative parameter values. While the estimates vary with parameter assumptions, we find that the effect of number-rigidity is likely to be substantial in most cases. We also stress that we calibrate the GL spillovers model because it is tractable and commonly cited in the literature. The GL model assumes an important role for firm size and that all large firms compete for CEO talent in a fully integrated labor market (in reality, spillovers may be stronger within compensation peer groups). However, spillover effects are likely to operate in any competitive environment, even if the exact assumptions used in the GL model do not hold.

5. Sources of Rigidity

5.1. *Two Broad Classes of Theories*

Thus far, we have shown that number-rigidity in option pay can account for a substantial portion of the rise in executive compensation during the tech boom. Had executives with number-rigid pay been compensated like similarly performing executives without number-rigid pay, aggregate compensation growth would have been considerably lower. Next, it is natural to ask why executives received number-rigid option pay in the first place. In the remainder of the paper, we examine this question. In particular, we attempt to distinguish empirically between two broad classes of theories.

5.1.1. *Optimal Contracting*

The first class of theories are ones in which all parties involved in the compensation-setting process understand how to value options but choose to grant the same number of options each year because this implements an optimal incentive scheme. For example, firms may grant number-rigid options

the variable definitions in Gabaix and Landier (2008).

to award very steep pay-for-performance incentives. As shown earlier in Fig. 5, number-rigidity leads to a steeper pay vs. firm return relation than that in a typical non-rigid compensation scheme. However, in theory, firms could target grant-date value in a flexible manner to implement any desired pay-for-performance relation without necessarily keeping number fixed.

Firms may also grant number-rigid options to manage executive ownership. In a classic principal-agent setting (e.g., Holmstrom, 1979; Holmstrom and Milgrom, 1987), optimal CEO ownership is a function of the cost of managerial effort, the degree of managerial risk aversion, and the randomness of output. To the extent that these factors remain constant over time, a firm may wish to keep CEO ownership constant as well. Number-rigidity may be one way of achieving that objective. However, in untabulated results, we find that executives with number-rigid pay still experience significant changes in their fractional ownership as measured by the Jensen–Murphy statistic (Jensen and Murphy, 1990).⁶ This is because options vest over time and executives choose to exercise their vested options at different points. In addition, even if number-rigidity did keep CEO ownership fixed, the above models imply that large stock price increases should lead to at least partial cash compensation offsets in order to prevent slackness in the participation constraint. As we show in the previous section, there is no evidence of such offsetting declines in cash compensation. Finally, Edmans et al. (2009) show theoretically that with multiplicative managerial production functions/preferences, it is not optimal for a CEO’s fractional ownership to remain constant. Since managerial effort has a larger dollar effect in larger firms, CEOs will work even when having a relatively small equity stake. Thus, fractional ownership should decrease when firm size increases due to high equity returns.

It is also worth noting that number-rigidity is not implied by other multiplicative compensation models such as Gabaix and Landier (2008). According to Gabaix and Landier (2008), holding the firm-CEO match fixed, CEO pay should increase with *market* returns rather than firm-specific returns because market returns are a better proxy for an executive’s outside option.

A final variation of the first class of theories are ones in which contracting frictions play an

⁶The Jensen–Murphy statistic is the dollar change in executive wealth for a \$1000 change in firm value and is calculated as the executive’s fractional equity ownership [(number of shares held + number of options held * average option delta) / (number of shares outstanding)] multiplied by \$1000. Option deltas and holdings are computed using the Core and Guay (2002) approximation as implemented by Edmans et al. (2009).

important role. In these theories, number-rigidity may not be optimal in a frictionless world, but it may be optimal once frictions are taken into account. Moreover, deviations from the first-best may be minor. For example, it may be costly to seek shareholder approval for a change in the number of options awarded to a CEO. Such menu costs might lead firms to adopt multi-year fixed number plans (Hall, 1999; Shue and Townsend, 2014). However, when firms do adjust the number of options granted, they should undo deviations from the first-best, as in an Ss-style model. As discussed earlier, however, this does not seem to be the case. Number-rigid grants followed by non-rigid grants are usually associated with increases rather than decreases in option pay, both in terms of number and value.

5.1.2. *Lack of Sophistication*

The second broad class of theories we explore include explanations in which at least one party in the compensation-setting process is somewhat unsophisticated about how to value options. Given that options are typically granted at-the-money, it is not immediately obvious that granting the same number of new options after a stock price increase would coincide with a pay increase. Fully understanding this notion requires knowledge of option pricing formulas that economists only derived relatively recently (Black and Scholes, 1973). There is ample anecdotal evidence that when option compensation first came into use, many did not understand or trust these formulas.

Instead of using option valuation formulas, people may have used the number of options awarded as a rough proxy for the value of the grant. This heuristic is similar to the well-known phenomenon of money illusion, or the tendency to think about money in nominal rather than real terms (Kahneman et al., 1986; Shafir et al., 1997). Given that it is considerably harder to translate number to value for options than it is to translate nominal to real for money, it seems plausible that a similar bias may operate in our context. Along these lines, in Section B in the Online Appendix, we summarize a survey conducted by a large compensation consulting firm.⁷ The survey suggests that executives viewed a decline in the number of options awarded following good performance as unfair, even if

⁷“Raising the Stakes: A Look at Current Stock Option Granting Practices,” 1998, Towers Perrin CompScan Report.

the decline in number coincided with an increase in value.

In addition, there were a variety of regulations that emphasized the number rather than value of options granted to executives. For example, up until 2006, the SEC only required the number of options granted to top executives to be reported in the compensation summary table of proxy statements. Similarly, FASB did not require the value of at-the-money option grants to be expensed in income statements until 2006. Finally, NYSE and NASD listing requirements also mandated shareholder approval for only the number of options granted. These regulations likely reflect, but also may have influenced, the way that compensation was commonly measured.

Importantly, lack of sophistication in the second class of theories may be on the part of the CEO or other stakeholders such as the board, shareholders, regulators, and/or lower-level employees. For example, shareholders may impose an outrage constraint that limits executive compensation. However, if shareholders do not fully understand that the value of compensation granted is rising even as number of options remains fixed, this outrage constraint may fail to bind. Similarly, if lower-level employees do not fully understand options, they may demand number-rigid option compensation. Number-rigid compensation may then percolate upwards toward the executive suite as a way to avoid pay inversion within the hierarchy of the firm.

5.2. Sensitivity to Reporting Requirements and Governance

We conduct a number of tests to help distinguish between the two classes of theories described above. In what follows, we present results pointing toward the second class of theories, suggesting that number-rigidity arises primarily from imperfect understanding of option valuation. However, we cannot rule out the possibility that, for a subset of firms, number-rigidity arises from optimal contracting.

We begin by testing whether firms become less likely to grant number-rigid options when they are required to expense or disclose the grant-date dollar value of those options on their income and proxy statements, respectively. If number-rigidity implements an optimal contract, the contract should remain optimal regardless of the way option compensation is reported to shareholders. However,

if number-rigidity arises from naïveté on someone’s part, changes in reporting requirements may reduce that naïveté.

To examine sensitivity to reporting requirements, we exploit two separate reforms by FASB and the SEC that went into effect in 2006. The FASB reform (effective for fiscal years ending after June 15, 2006) required firms to subtract the total Black–Scholes value of option compensation paid to all employees from reported earnings. For brevity we will refer to this practice as “required expensing.” The SEC reform (effective for fiscal years ending after December 15, 2006) required firms to disclose the Black–Scholes value of option compensation paid to each proxy-named executive on the firm’s proxy statements. We will refer to this practice as “required disclosure.” We exploit these reforms to test whether number-rigidity declines when option pay is expensed or disclosed transparently in dollar terms to shareholders. To control for concurrent time trends, we use a differences-in-differences framework with stock compensation as a control group. Stock compensation also has a number and value associated with it, but its value had to be disclosed and expensed throughout our sample period. Because the two reforms coincide so closely, it is difficult to distinguish their effects empirically. We begin by estimating the combined effect of the two reforms. In particular, we exclude observations with fiscal years ending between June 15, 2006 and December 15, 2006, because in these fiscal years only the FASB reform was in effect. In subsequent analysis, we attempt to separately estimate the effect of expensing and disclosure.

Table 3 explores the effects of these reforms. Observations are at the executive by year by grant type level, where grant type represents option grants or stock grants. The sample is restricted to S&P 500 CEOs who received the relevant grant type in the current year and in the previous year. Thus, a CEO receiving both stock and options compensation would have two observations per year. Our dependent variable is a number-rigid (number-reference) indicator variable equal to one if the stock or option grant under observation is number-rigid (number-reference) relative to the grant of the same type in the previous year. We define number-rigid (number-reference) grants for stock analogously to options (see Section 3.2). The primary independent variables are an indicator equal to one if the grant was awarded after the reforms went into effect, an indicator equal to one if the

grant was in the form of options (rather than stock), and the interaction between the two. The regressions show that, throughout our sample period, option grants are significantly more likely to be number-rigid than stock grants. This is consistent with the idea that converting number to value is harder for options than for stock, leading to greater money-illusion type thinking. If option compensation were number-rigid for incentive reasons, for example, to keep CEOs' ownership stake at a certain level, one would expect a similar level of number-rigidity for stock compensation. Likewise, one would expect a similar level of number-rigidity for stock compensation if number-rigidity were primarily designed to ensure that compensation grows one-for-one with returns.

We also find that the rule changes had no effect on number-rigidity for stock grants, consistent with the fact that the changes only targeted options. In particular, the coefficient on *Post-Reforms* is insignificant except for in Column 3, where we do not include controls. Finally, and most importantly, we estimate a significant negative coefficient on the interaction term. This shows that the probability of number-rigidity declined more for options than for stock following the rule changes (the difference between number-rigidity in stocks and options is approximately cut in half).

Note that these results are not driven by a general decline in the use of options following the rule changes. The use of option compensation did decline after 2006; however, Table 3 shows that, conditional on granting options, the probability that the options were number-rigid declined significantly. Similarly, our results are not driven by option-granting firms simply reducing option compensation in the year of the reforms, which would lead to lower number-rigidity that year. We actually find stronger results if we exclude a larger window around the reforms. Overall, our findings are consistent with the idea that number-rigidity at least partly results from inattention to value. However, it remains possible that a subset of firms use number-rigidity to implement an optimal (or near-optimal) contract along the lines outlined in Section 5.1.1. In particular, the few firms that continue to use number-rigid option pay after the disclosure and expensing reforms may have done so because number-rigidity implements their optimal incentive scheme. Similarly, optimal contracting may help explain why, to a lesser extent, number-rigidity also exists for stock compensation as shown earlier in Fig. 4 (even though the value of stock compensation is relatively

easy to calculate and had to be expensed and disclosed throughout our sample period). For this subset of firms, number-rigid stock compensation may again implement an optimal or near-optimal compensation scheme.

The above results suggest that some combination of expensing and disclosure reduces number-rigidity in option pay. An important remaining question is whether it is primarily expensing or disclosure that is responsible for the reduction. One approach would be to examine whether number-rigidity declined in fiscal years ending between June 15, 2006 and December 15, 2006, when required expensing was in effect but not required disclosure. Given the shortness of the time window, such a test has limited statistical power. However, we show in Table A4 in the Online Appendix that there is indeed a significant decline in number-reference grants during those months, suggesting that expensing without disclosure does have an effect.

To shed further light on this question, we exploit the fact that, prior to the reforms, some firms voluntarily chose to expense and/or disclose. In particular, with the passage of FAS123 in 1995, FASB gave firms the option of (1) expensing the Black–Scholes value of option awards or (2) expensing the intrinsic value, which is zero when options are granted at-the-money, as is typically the case.⁸ Virtually all firms chose to expense the (zero) intrinsic value of option grants until a few years preceding the passage of FAS123r, when some switched voluntarily.

Similarly, prior to the SEC rule change in 2006, all non-option components of executive pay were stated in dollar terms in the compensation summary table of a proxy statement, while option pay was stated in number terms. In the detailed option table, firms had the choice of reporting Black–Scholes value or potential realizable value, which stated what the future intrinsic value of the options would be under 5% and 10% stock price appreciation scenarios. Again, the majority of firms elected not to disclose Black–Scholes value, although some did do so voluntarily (Murphy, 1996).⁹

⁸When options were expensed at intrinsic value, a footnote was required stating what earnings would have been if firms had instead expensed the total Black–Scholes value of all employee stock options. However this footnote may not have been very salient as it did not affect the main reported earnings numbers. In addition many firms prefaced the footnote by stating their belief that Black–Scholes was not a sensible methodology.

⁹Because potential realizable value also increases proportionally with the stock price, one may argue that even reporting this number should reduce naïveté. However, this information did not appear in the compensation summary

To test how voluntary expensing and disclosure relate to number-rigidity, we hand collect data on voluntary expensing from firm 10-K filings. In particular, for each firm that was ever a part of the S&P 500 in our data, we go through its 10-K filings following the passage of FAS123 in October 1995. We record the date (if any) that the firm first expensed the Black–Scholes value of option compensation through 1) the voluntary adoption of the fair value provisions of FAS123 or 2) the voluntary early adoption of FAS123r.¹⁰ Based on these dates, we create a *Voluntary Expensing* indicator variable equal to one if the firm voluntarily expensed option compensation in a given year. Similarly, we create a *Voluntary Disclosure* indicator variable based on the PCDVALUE variable in Execucomp. For fiscal years ending between December 15, 1996 and June 15, 2006, all firms could choose to expense or disclose. Therefore, for this sample period, we regress number-rigidity on both the voluntary expensing and voluntary disclosure indicators. The results are shown in Table 4. To increase power, we expand our sample to include all top executives (rather than only CEOs) at firms that were ever a part of the S&P 500 during our sample period. We find that grants become significantly less likely to be number-rigid and number-reference when firms voluntarily expense, but voluntary disclosure has a statistically insignificant effect. The results remain relatively unchanged with the inclusion of firm fixed effects in Columns (2) and (4). Thus, it does not appear that the results are driven by time-invariant unobservable differences between the types of firms that choose to expense or disclose and those that choose not to. Overall, these results show that expensing the grant-date value of options (which leads to lower reported earnings) has a greater effect on how the cost of option awards is viewed than merely disclosing the value. One reason may be that proxy disclosures do not reflect the views of the CEO or board but are merely made by accountants and lawyers hired by the firm.

Finally, in Table 5, we test how various board characteristics relate to number-rigidity. To further increase power, we expand our sample to include all top executives at firms that were ever

table and thus may have been less salient. Moreover, potential realizable value represents a scenario analysis and thus is less likely to be viewed as a measure of the grant’s *current* value. In fact, because potential realizable value is tied to the intrinsic value of the options, this measure may still encourage the idea that the current value is zero for at-the-money options.

¹⁰FAS123r was issued in December 2004. After its issuance, firms did not have to adopt it until their first fiscal year starting after June 15, 2006. However, some firms adopted it before they were required to.

a part of the S&P 1500 during our sample period. It is plausible that firms with more independent or sophisticated boards are more likely to choose optimal compensation structures or to be aware of option valuation methods. We find that boards with a greater percentage of directors that are independent, a greater percentage of independent directors that joined before the current CEO, or a greater percentage of independent directors with an MBA degree are significantly less likely to grant number-rigid options. This again cuts against the first class of theories, in which number-rigidity arises from optimal contracting, as it seems that number-rigidity is correlated with proxies for worse governance.

5.3. *Sophistication*

Given that transparency and governance reduce number-rigidity, one may wonder whether CEOs and/or boards always understood the value-implications of number-rigidity. To investigate the degree of CEO/board sophistication, we examine whether the probability of CEOs receiving number-rigid grants is asymmetric with respect to firm returns. If CEOs or boards are sophisticated about option valuation and want to reward good performance and also to bound losses following poor performance, they would implement number-rigid pay when their firm had positive returns but not when their firm had negative returns. Panel A of Figure 8 shows a local linear regression in which the number-rigid indicator is regressed on firm returns in the year prior to the option grant date. We limit the sample to CEOs of firms that were ever a part of the S&P 500 over our sample period and use the Epanichnikov kernel with the rule-of-thumb bandwidth. We find that, indeed, the probability of a CEO receiving number-rigid pay following very positive returns (when rigidity would lead to large pay increases) is considerably higher than the probability following very negative returns (when rigidity would lead to large pay declines). This asymmetry is consistent with at least some CEOs or boards recognizing that the value of the same number of new options varies with their firm's stock price. Panel B shows that the asymmetry is weaker among the sample of all S&P 1500 executives.

In contrast to the previous result, we also find evidence suggesting that some CEOs do endure

large losses in value due to number-rigidity. Specifically, we examine whether executives continue to receive the same (non-split adjusted) number of options as in the previous year following a positive stock split. The compensation survey cited earlier suggests this may be the case. The survey finds that, following a split, roughly half of number-rigid firms hold their (non-split adjusted) number of options fixed. The report concludes that: “Stock splits also offer an opportunity to readjust grant levels, moving back toward more competitive levels, without jolting employees’ perceptions or expectations quite so drastically.”

To more formally test whether there is evidence of such behavior, we limit our sample to firms that engaged in a positive stock split between the time of the previous option grant and the current grant. Panel A of Fig. 9 shows the distribution of growth in the (non-split-adjusted) number of options granted in the current year relative to the previous year. For both the sample of S&P 500 CEOs and S&P 1500 Top Executives, following a stock split, the modal percentage change in the number of options granted is 100%; this corresponds to split-adjusted number-rigidity following a 2-for-1 split. However, the second most common occurrence is for the number of options granted to remain the same as in the previous year, despite the split. This is in contrast to stock compensation, where, following a split, very few executives receive the same number of shares as they did in the previous year. Overall, these results are consistent with naïveté regarding options. Following positive stock splits, CEOs who continue to receive the same number of options typically experience a 50% decline in the value of their option compensation, all else equal.¹¹

In Panel B of Fig. 9, we explore whether the decline in option compensation from lack of split-adjustments is offset by an increase in non-option compensation. The sample is limited to the set of observations in which the (non-split-adjusted) number of options awarded remains constant following a positive stock split. The figure plots the change in non-option compensation against the loss in value due to the lack of split adjustment in the number of options granted. The dotted

¹¹One important concern is that the above results may be driven by reporting errors. In our analysis, we assume that, as required by the SEC, firms report their compensation for the previous fiscal year in terms of the correct units as of the proxy date. It is possible that some firms violate these requirements. However, the most obvious type of potential reporting errors would actually lead us to find a smaller spike at zero in Panel A of Fig. 9 than exists in reality. Moreover, we confirm that our results are very similar using only observations that are unlikely to have reporting errors as well as using alternative data sources. See Section C of the Online Appendix for details.

line shows the change in other compensation necessary to fully offset these losses. The solid line represents the relation between the actual change in non-option compensation and the losses due to the lack of the split adjustment, as estimated using a local linear regression. As can be seen, the smoothed regression line is relatively flat. Moreover, the difference between the two lines is also statistically significant in a linear regression. Thus, non-option compensation does not change to offset the loss of option compensation due to the lack of split adjustment. Again, these findings seem to run counter to optimal contracting theories, in which all parties understand option valuation.

6. Conclusion

Several theories have been proposed to explain the dramatic rise in CEO pay during the 1990s and early 2000s. In this paper, we explore an alternative and complementary explanation, based on the observation that there is a high degree of rigidity in the number of options CEOs receive. Number-rigidity in option compensation implies that the grant-date value of option pay will grow with firm equity returns, which were very high on average during the tech boom. We also show that salary, bonus, and other non-option compensation did not adjust downward to offset the rigidity-induced increases in option pay. Moreover, there are compensation spillovers from executives that receive number-rigid option pay to those that do not. Finally, we present evidence that number-rigidity arises from a lack of sophistication about option valuation that is akin to money illusion. In particular, we show that number-rigidity is more prevalent for option compensation than stock compensation, which is easier to value. Moreover, option number-rigidity *declines* relative to stock number-rigidity when firms (voluntarily or involuntarily) begin to disclose and expense the grant-date value of their option pay. In particular, firms are significantly less likely grant number-rigid options if they expense the grant-date value of options on their income statements. Finally, improved governance also corresponds to reduced number-rigidity in options.

Overall, we conclude that number-rigidity in options can explain a substantial portion of the off-trend growth in CEO compensation during the tech boom. Number-rigidity can also explain the

increased dispersion in CEO pay, the difference in pay growth between the US and other countries, and the increased correlation between pay and firm-specific equity returns. Finally, the decline in number-rigidity, resulting from changes in reporting requirements, helps to explain why executive pay increased less with the high equity returns during the housing boom in the mid-2000s.

Figure 2
CEO Compensation Over Time

This figure is created following the methodology in Murphy (2013). The sample is restricted to CEOs of firms that were ever a part of the S&P 500 from 1992 to 2010. The height of each bar represents the median level of total compensation each year in 2011 dollars. In addition, each bar is decomposed into the mean proportion represented by each component of compensation in each year. The bonus component includes compensation included in non-equity incentive plans and long-term incentive plans. All components of compensation are calculated using grant-date values instead of realized values at exercise.

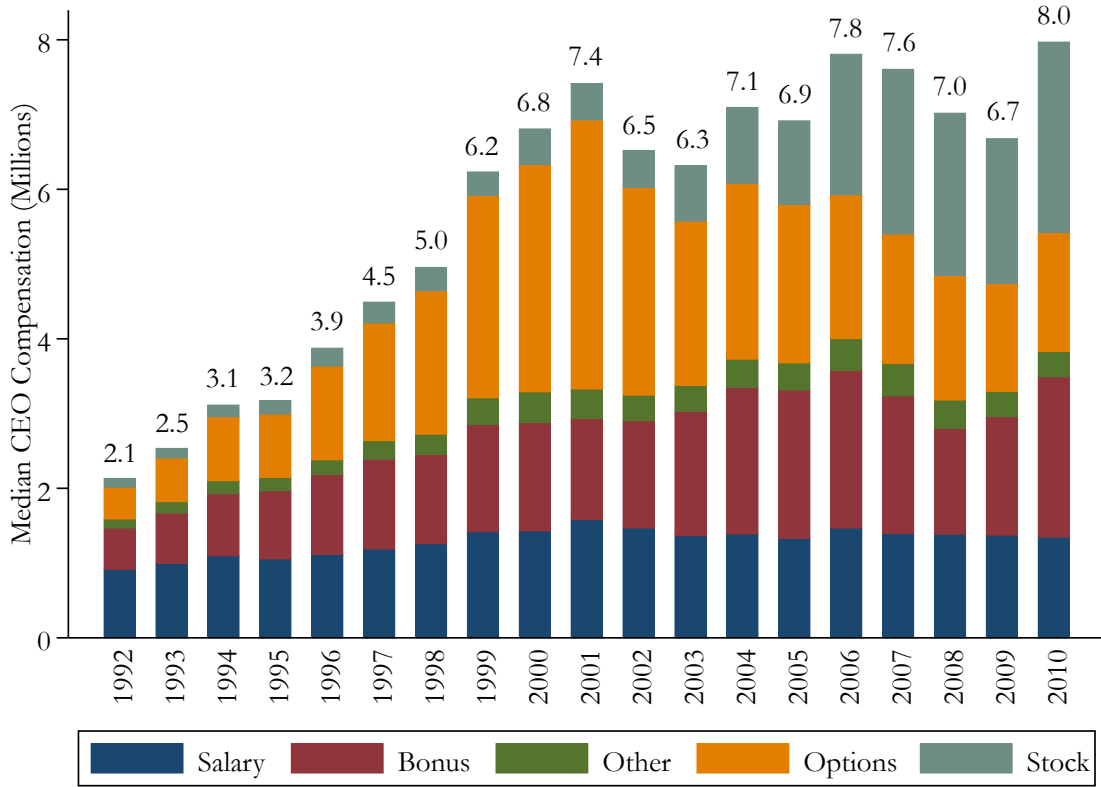


Figure 3

Compensation for CEOs vs. Other High-Income Households

The solid lines show the evolution of median option compensation, median non-option compensation, and median total compensation for the sample of CEOs of firms that were ever a part of the S&P 500 from 1992 to 2010. The dotted lines show the evolution of income for the top 0.1% and top 1% of US tax units (including individual and joint tax filers). Data on income are the updated version of those from Piketty and Saez (2003). All values are adjusted for inflation using the CPI index and normalized to equal one in the year 1992.

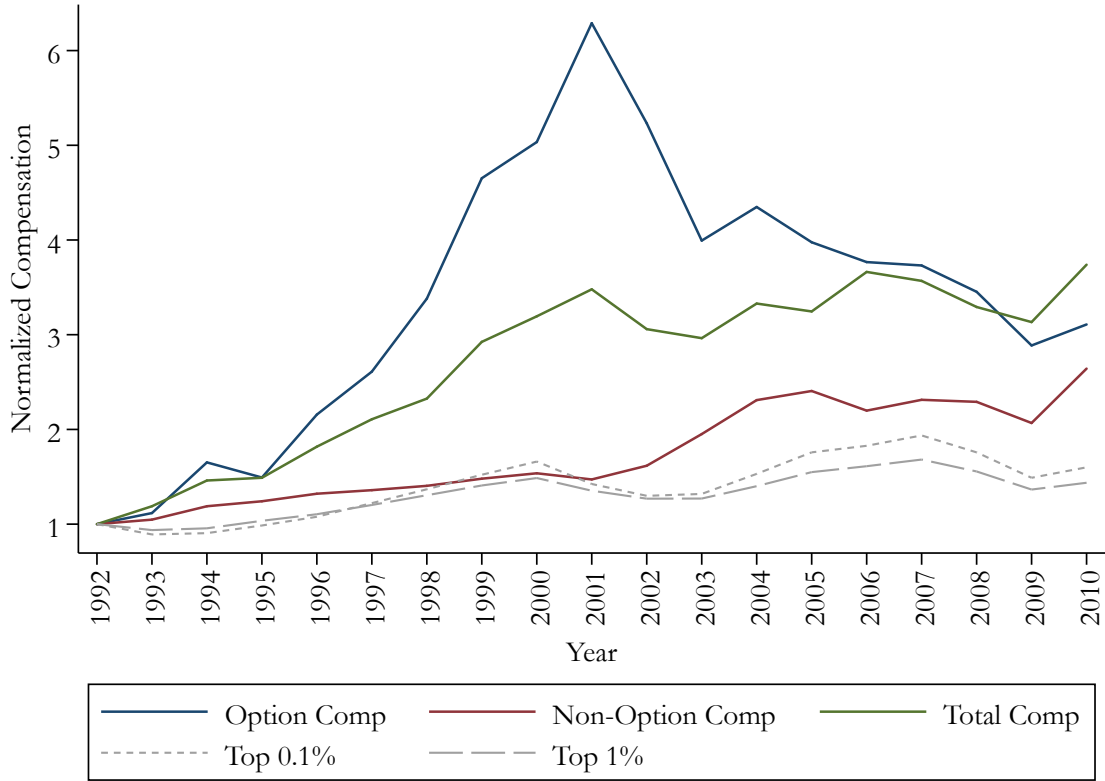
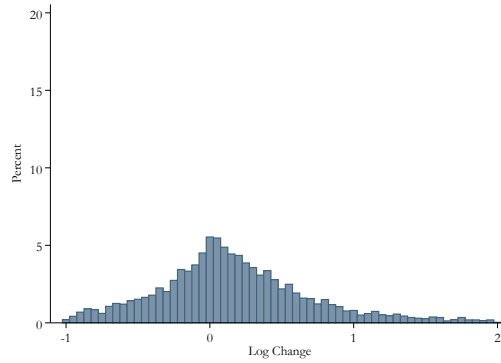


Figure 4

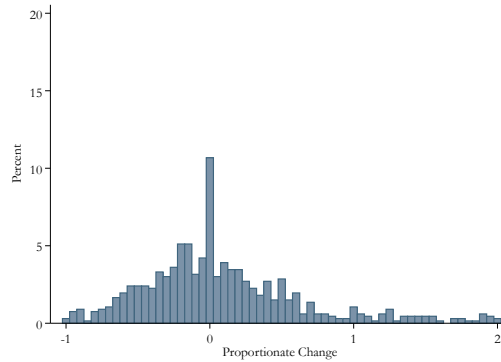
Distribution of Change in Option and Stock Grants

Panel A shows the log change in the nominal grant-date Black–Scholes value of options granted. The sample is limited to CEOs who receive options in the current and previous year at firms that were ever a part of the S&P 500 from 1992 to 2010. Panel B shows the proportional change in the number of shares of stock granted in the current year relative to the previous year. Panel C shows the log change in the nominal grant-date value of shares granted in the current year relative to the previous year. The sample in Panels B and C is limited to CEOs who receive stock grants in the current and previous year at firms that were ever a part of the S&P 500 from 1992 to 2010.

Panel A: B–S Value of Options Granted



Panel B: Number of Shares Granted



Panel C: Value of Shares Granted

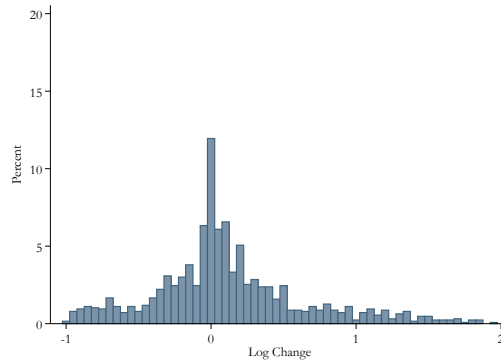


Figure 5

Option Value Growth For Number-Rigid and Non-Rigid CEOs

This figure plots changes in the log grant date value of new options against the log firm return over the previous 12 months. For the number-rigid and non-rigid samples, we fit a local linear regression using the Epanichnikov kernel and the rule-of-thumb bandwidth. The sample is limited to CEOs who receive options in the current and previous year at firms that were ever a part of the S&P 500 from 1992 to 2010.

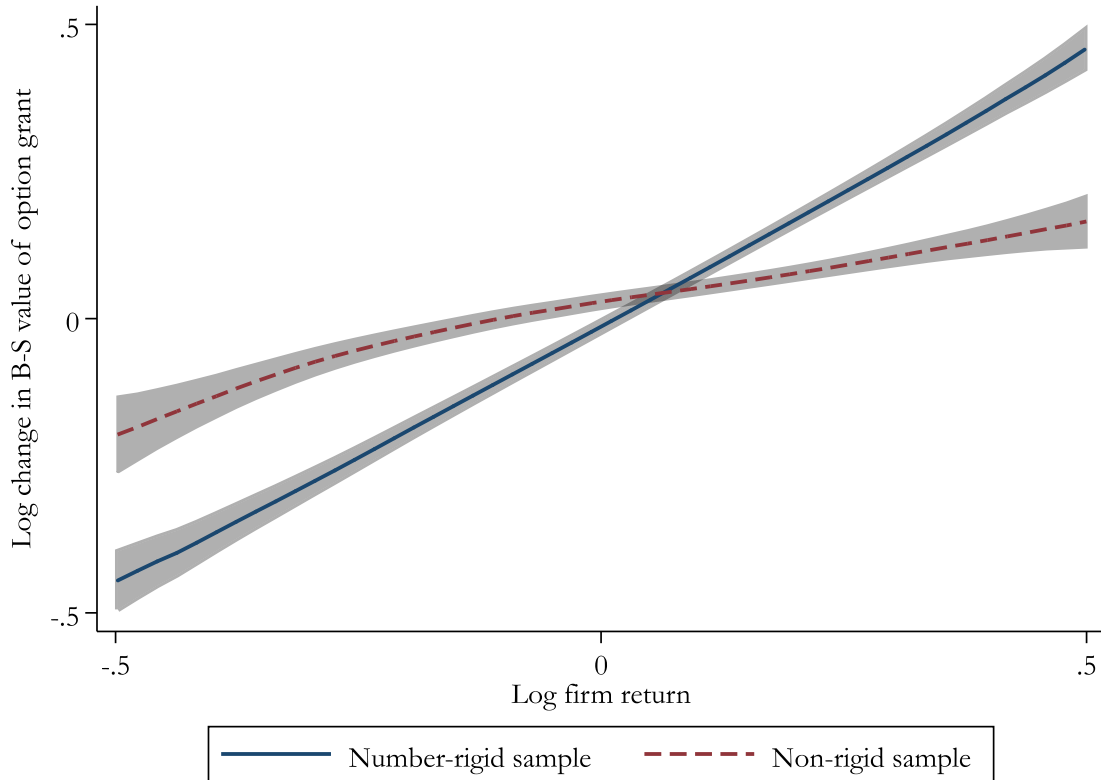
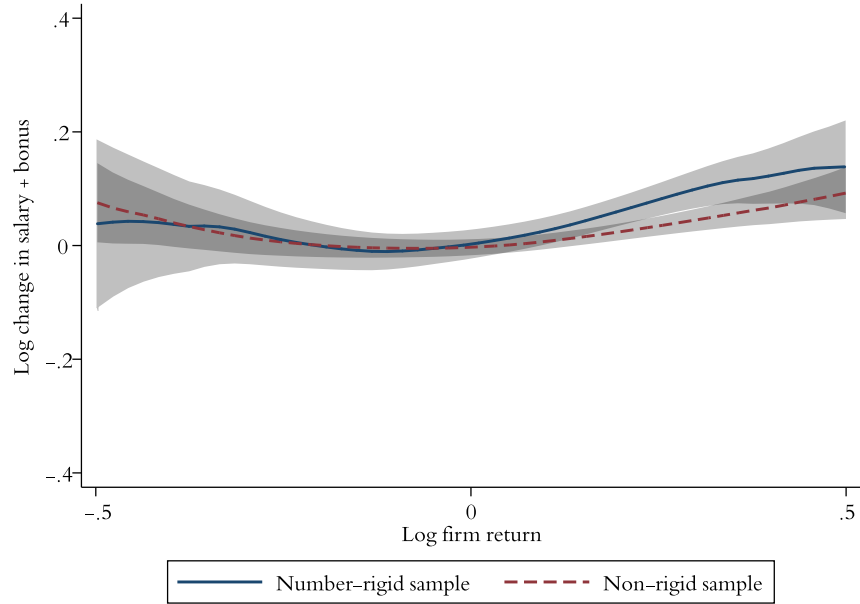


Figure 6

Offsets in Non-Option Compensation

This figure reproduces 5 using the same sample, with the y-axis now representing cash compensation (salary plus bonus) in Panel A and all non-option compensation in Panel B.

Panel A: Cash Compensation



Panel B: All Non-Option Compensation

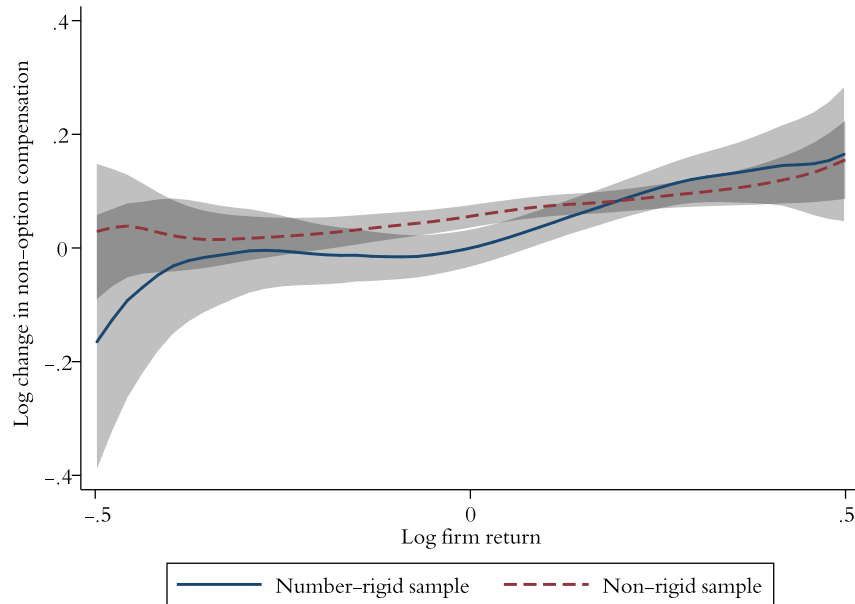


Figure 7

The Effect of Number-Rigidity on Aggregate Compensation

In this figure we calibrate an equilibrium model CEO pay from Gabaix and Landier (2008) to estimate the potential magnitude of the effect of number-rigidity on aggregate compensation. We use the sample of all firms that were a part of the S&P 500 from 1992 to 2010. We assume that f is the fraction of number-rigid CEOs in each year of our data and that the probability of being number-rigid is uncorrelated with size (an assumption that is approximately true within our sample). The parameter λ is equal to the average difference between actual and counterfactual pay growth each year in the non-rigid sample, using realized returns in each year and the relationship estimated in Appendix Figure A4. For other model parameters, we use $\gamma = 0.5$, $\alpha = 1$, and $\beta = 0.3$. The short-dashed line shows cumulative growth that can be attributed to number-rigidity (including spillovers), assuming that growth absent number-rigidity would have been zero. The long-dashed line shows cumulative growth that can be attributed to a combination of number-rigidity and changes in size of the typical firm. The size of the typical firm in each year is calculated as the debt plus equity (Compustat codes: `prcc_f*abs(csho)+at-ceq-txdb`) of the 250th largest firm in each year, measured in 2000 dollars, following the variable definitions in Gabaix and Landier (2008).

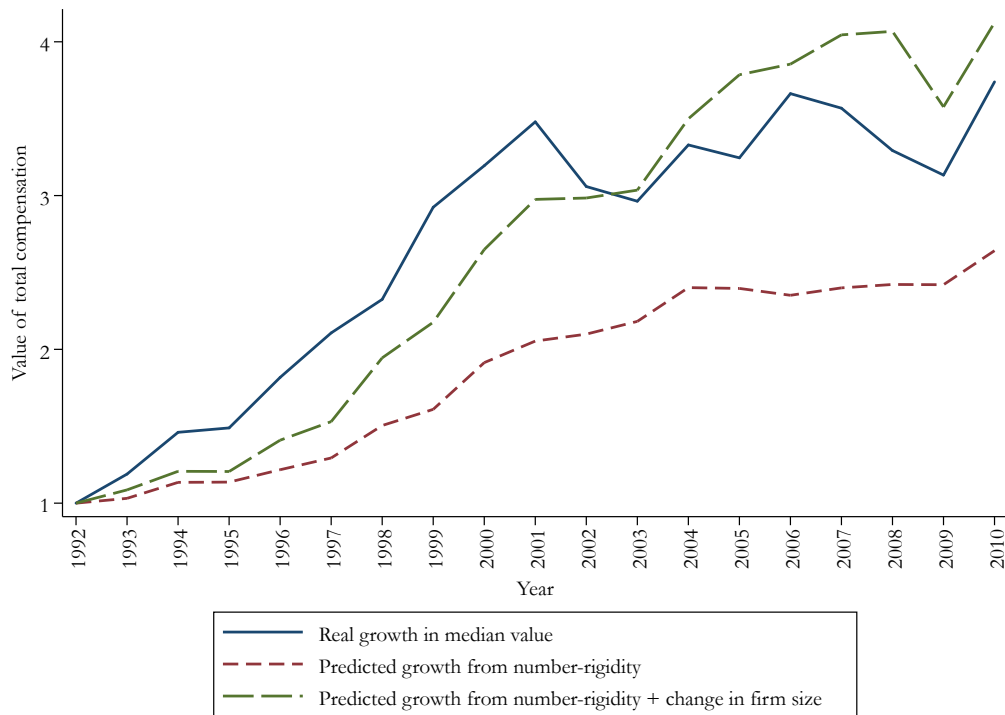


Figure 8

Asymmetry

This figure shows a local linear regression in which the number-rigid indicator is regressed on firm returns in the year prior to the option grant date. We use the Epanichnikov kernel with the rule-of-thumb bandwidth. In Panel A, the sample is limited to CEOs who receive options in the current and previous year at firms that were ever a part of the S&P 500 from 1992 to 2010. In Panel B, the sample is limited to all top executives who receive options in the current and previous year at firms that were ever a part of the S&P 1500 from 1992 to 2010.

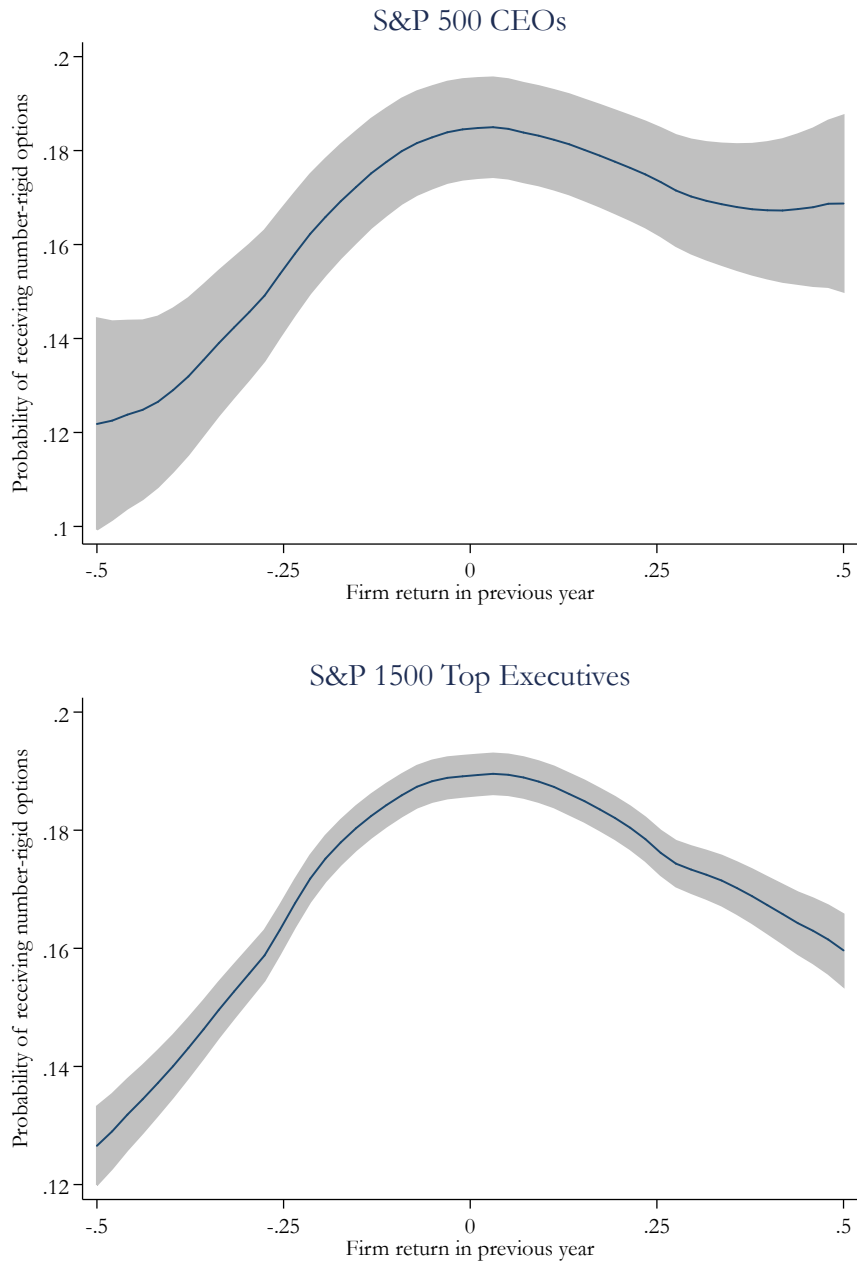
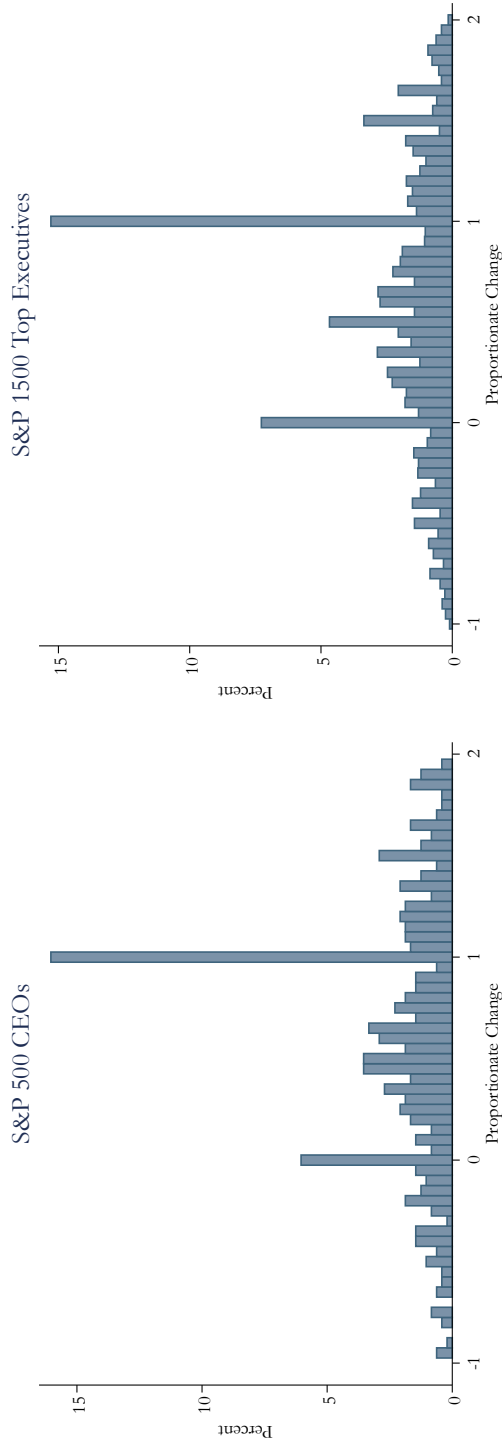


Figure 9
Adjustment to Splits

In Panel A, the sample is limited to firms that engaged in a positive stock split between the time of the previous option grant and the current grant. Panel A shows the distribution of the proportional change in the non-split adjusted number of options granted in the current year relative to the previous year. Following these positive stock splits, executives who continue to receive the same number of options (proportionate change equal to zero) receive a substantial decline in the value of their option grant, all else equal. In Panel B, the sample is limited to the set of executive-years in which option number remains constant following a positive stock split. The figure plots the change in non-option compensation against the loss in value due to the lack of split adjustment in the number granted. The dotted line shows the change in other compensation necessary to fully offset the losses. The solid line represents the relationship between the actual change in non-option compensation and the losses due to the lack of the split adjustment, as estimated using a local linear lowess regression. The sample in Panel B consists of all S&P 1500 top-executive years.

Panel A: Change in Number of Options Granted Following a Split



Panel B: Adjustment of Non-Option Compensation

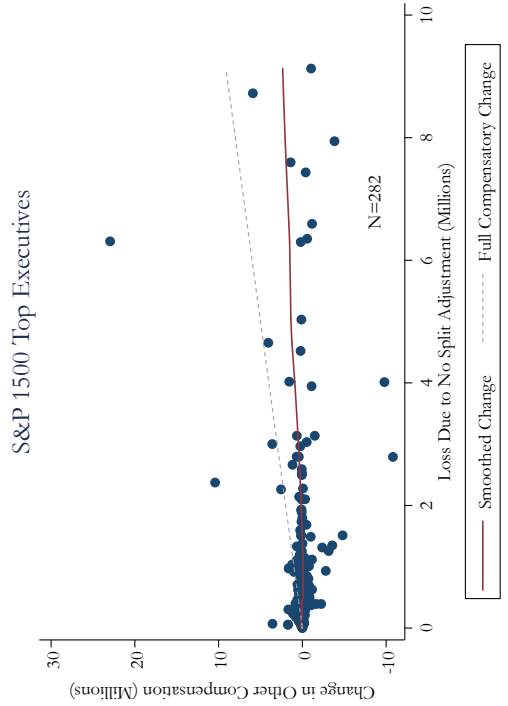


Table 1
Summary Statistics

This table reports summary characteristics for the sample of all firms that were ever a part of the S&P 500 from 1992 to 2010. The table is divided between number-rigid firms, number-reference firms, and all other firms where options were paid in the current and previous year. A firm is categorized based on the pay of the CEO that year (relative to the previous year). Because the prevalence of number-rigidity has changed over time, we present the summary statistics separately for three cross-sections in 1995, 2000, and 2005.

	Number Rigid					Number Reference					Other					
	N	p25	p50	p75	N	p25	p50	p75	N	p25	p50	p75	N	p25	p50	p75
Year: 1995																
Assets (Millions)	78	1223.86	3965.55	11955.90	189	1003.78	3473.40	13253.00	251	1963.60	5015.97	14282.00				
Market to Book	78	1.15	1.44	1.98	189	1.15	1.45	2.07	251	1.15	1.52	2.09				
CAPX / PPE	69	0.14	0.19	0.27	166	0.14	0.21	0.35	221	0.14	0.20	0.29				
Market Leverage	78	0.11	0.20	0.36	188	0.09	0.21	0.38	251	0.10	0.20	0.35				
Book Leverage	78	0.26	0.41	0.53	188	0.24	0.42	0.57	251	0.23	0.40	0.56				
Total Dividends (Millions)	78	10.73	44.59	154.41	189	4.42	44.48	141.24	251	18.79	66.90	195.00				
Firm Return	78	0.08	0.30	0.48	189	0.12	0.30	0.50	251	0.12	0.29	0.47				
Return on Assets	78	0.03	0.07	0.10	189	0.02	0.06	0.10	251	0.02	0.05	0.09				
Cash Flow / Assets	69	0.09	0.12	0.17	165	0.09	0.12	0.17	222	0.08	0.12	0.16				
Year: 2000																
Assets (Millions)	60	1742.21	5957.98	14881.40	170	1985.15	6710.02	16767.24	312	2239.32	5631.26	19578.00				
Market to Book	60	1.17	1.65	3.24	169	1.19	1.67	3.21	312	1.14	1.53	2.83				
CAPX / PPE	56	0.14	0.18	0.28	154	0.14	0.21	0.38	272	0.14	0.21	0.36				
Market Leverage	59	0.08	0.18	0.42	168	0.05	0.17	0.42	312	0.06	0.21	0.44				
Book Leverage	59	0.26	0.42	0.59	169	0.24	0.39	0.58	312	0.26	0.46	0.62				
Total Dividends (Millions)	60	0.00	30.23	162.55	168	0.00	28.07	166.15	310	0.00	58.20	230.60				
Firm Return	60	-0.12	0.15	0.44	170	-0.18	0.12	0.41	309	-0.18	0.14	0.49				
Return on Assets	60	0.03	0.07	0.13	170	0.02	0.07	0.13	312	0.02	0.05	0.10				
Cash Flow / Assets	53	0.08	0.15	0.19	153	0.08	0.13	0.20	283	0.06	0.11	0.17				
Year: 2005																
Assets (Millions)	60	3104.27	10216.69	28330.50	145	2940.00	6869.61	21633.00	279	3878.98	9727.00	29141.20				
Market to Book	60	1.26	1.76	2.39	145	1.30	1.78	2.47	278	1.23	1.64	2.35				
CAPX / PPE	60	0.12	0.16	0.29	143	0.13	0.19	0.32	263	0.13	0.19	0.28				
Market Leverage	60	0.06	0.14	0.29	145	0.04	0.11	0.27	278	0.08	0.15	0.34				
Book Leverage	60	0.16	0.31	0.51	145	0.12	0.29	0.46	279	0.21	0.35	0.59				
Total Dividends (Millions)	60	4.15	103.50	243.50	145	0.00	62.53	225.11	276	0.00	90.61	291.36				
Firm Return	60	-0.08	0.07	0.25	145	-0.07	0.07	0.28	279	-0.05	0.08	0.27				
Return on Assets	60	0.02	0.06	0.10	145	0.03	0.07	0.11	279	0.02	0.07	0.11				
Cash Flow / Assets	57	0.06	0.09	0.14	139	0.06	0.11	0.16	271	0.05	0.11	0.17				

Table 2

Spillovers from Number-Rigid to Non-Rigid CEOs

This table shows the effect of number-rigid peers on the compensation of non-rigid CEOs. Observations are at the executive by year level. The sample consists of CEOs at firms that were a part of the S&P 500 from 1992–2010. We match each CEO in our sample to CEOs of peer firms. Following Faulkender and Yang (2010), we define peer firms as firms in the same industry (2-digit SIC code) with sales between 50% and 200% of the CEO’s firm. We set the CEO’s compensation date as the date of the largest option grant from the fiscal year. When a CEO does not have an option grant in a fiscal year, we assign an artificial compensation date 270 days prior to the firm’s fiscal year end. For each CEO, we define *Percent Peers Rigid* and *Percent Peers Reference* as the percent of peer CEOs (with compensation dates within the past 365 days) that had number-rigid or number-reference option grants, respectively. The variable *Number Reference* is an indicator equal to one if the split-adjusted number of options granted in the current year is the same as in the previous year. The variable *Number Rigid* is an indicator equal to one if the ratio of the split-adjusted number of options granted in the current year relative to the previous year equals $1 \pm$ a multiple of $1/2, 1/4, \dots, 1/10$. We also define *Peer Returns* as the average firm return of peer firms in the year leading up to each peer’s compensation date. In Columns (1)–(3), the sample consists of CEOs without a number-rigid option grant. In Columns (4)–(6), the sample consists of CEOs with a number-reference option grant. The dependent variable is the log change in total compensation. Firm controls include assets, leverage-to-book ratio, return on assets, market-to-book ratio, and capital expenditures to lagged PP&E. Standard errors are clustered by firm. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Log Change Total Compensation					
	(1)	(2)	(3)	(4)	(5)	(6)
Peer Returns	0.104*** (0.0369)	0.0892** (0.0385)	0.0617 (0.0447)	0.0502 (0.0461)	0.0375 (0.0485)	0.00267 (0.0576)
Percent Peers Rigid	-0.0335 (0.0736)	-0.0141 (0.0778)	-0.00748 (0.0927)			
Peer Returns \times Percent Peers Rigid	0.618** (0.306)	0.752** (0.292)	0.759** (0.329)			
Percent Peers Reference				-0.0148 (0.0522)	-0.0213 (0.0567)	-0.0443 (0.0668)
Peer Returns \times Percent Peers Reference				0.446** (0.194)	0.471** (0.194)	0.550** (0.222)
Sample Controls	Non-Rigid No	Non-Rigid Yes	Non-Rigid Yes	Non-Ref No	Non-Ref Yes	Non-Ref Yes
Firm FE	No	No	Yes	No	No	Yes
R ²	0.00215	0.00279	0.0538	0.00178	0.00220	0.0743
Observations	10022	9029	9029	8445	7611	7611

Table 3**Combined Effect of FASB and SEC Reforms on Number-Rigidity**

This table shows how the prevalence of number-rigid and number-reference option grants change relative to stock grants after the FASB and SEC reforms in 2006. The FASB reform (effective for fiscal years ending after June 15, 2006) required firms to subtract the total Black–Scholes value of option compensation paid to employees from earnings. The SEC reform (effective for fiscal years ending after December 15, 2006) required firms to disclose the Black–Scholes value of option compensation paid to each top executives on their proxy statements. Stock compensation also has a number and value associated with it, but its value had to be disclosed and expensed throughout our sample period. Observations with fiscal years ending between June 15, 2006 and December 15, 2006 are excluded because in these fiscal years only the FASB reform was in effect. Observations are at the executive by year by grant type level, where grant type represents option grants or stock grants. The sample is restricted to S&P 500 CEOs who received the relevant grant type in the current year and in the previous year. Thus, a CEO receiving both stock and options compensation would have two observations for that year. Our dependent variable is a number-rigid (number-reference) indicator variable equal to one if the stock or option grant under observation is number-rigid (number-reference) relative to the grant of the same type in the previous year. We define number-rigid (number-reference) grants for stock analogously to options (see Table 2). The variable *Post-Reforms* is an indicator equal to one if the award is granted following the two reforms (fiscal years ending after December 15, 2006). The variable *Options* is an indicator variable equal to one if the grant is an option grant and zero if the grant is a stock grant. Time trends include a linear time trend. Firm controls include assets, leverage-to-book ratio, return on assets, market-to-book ratio, capital expenditures to lagged PP&E, and firm returns. Standard errors are clustered by firm. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Number Rigid		Number Reference	
	(1)	(2)	(3)	(4)
Post-Reforms	-0.00531 (0.0112)	-0.00103 (0.0173)	-0.0467*** (0.0171)	0.00308 (0.0236)
Options	0.0937*** (0.00862)	0.0841*** (0.00972)	0.207*** (0.0144)	0.189*** (0.0159)
Post-Reforms × Options	-0.0387*** (0.0143)	-0.0302** (0.0146)	-0.130*** (0.0211)	-0.124*** (0.0216)
Time Trend	No	Yes	No	Yes
Controls	No	Yes	No	Yes
Firm FE	No	Yes	No	Yes
R ²	0.0158	0.0139	0.0525	0.0534
Observations	10004	9754	10004	9754

Table 4
Voluntary Expensing and Disclosure

This table shows how number-rigidity relates to voluntary expensing and disclosure. Observations are at the executive by year level. The sample consists of all top executives that were part of the S&P 500 from 1992–2010 (that received options in the current and previous year). The variable *Voluntary Expensing* is an indicator equal to one if the firm voluntarily expensed the Black–Scholes value of option compensation on its income statement, either through 1) the voluntary adoption of the fair value provisions of FAS123 or 2) the voluntary early adoption of FAS123r. The variable *Voluntary Disclosure* is an indicator variable equal to one if the firm voluntarily reported the Black–Scholes value of option compensation paid to each top executive in its proxy statement. In the first two columns, the dependent variable is a number-rigid indicator variable defined as described in Table 2. In the second two columns, the dependent variable is a number-reference indicator variable as described in Table 2. The sample period is limited to firms with fiscal years ending between December 15, 1996 and June 15, 2006 as all firms could choose to voluntarily expense or disclose during that time period. Firm controls include assets, leverage-to-book ratio, return on assets, market-to-book ratio, capital expenditures to lagged PP&E, and firm returns. Industry fixed effects use the Fama–French 49 industry classification. Standard errors are clustered by firm. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Number Rigid		Number Reference	
	(1)	(2)	(3)	(4)
Voluntary Expensing	-0.0562*** (0.0214)	-0.0462* (0.0237)	-0.108*** (0.0336)	-0.0895*** (0.0317)
Voluntary Disclosure	0.00649 (0.0143)	0.0122 (0.0212)	-0.0226 (0.0209)	0.00602 (0.0274)
Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes
R ²	0.0226	0.204	0.0418	0.293
Observations	18105	18105	18105	18105

Table 5

Board Characteristics

This table shows how number-rigidity relates to various board characteristics. Observations are at the executive by year level. The sample consists of all top executives that were part of the S&P 1500 from 1992–2010 (that received options in the current and previous year). In the even columns, the dependent variable is a number-rigid indicator variable as described in Table 2. In the odd columns, the dependent variable is a number-reference indicator variable as described in Table 2. The variable *Board Size* represents the total size of the board. The variable *Percent Independent* represents the percent of the board that consists of independent directors. The variable *Percent Pre-CEO* represents the percent of the independent directors that were appointed before the current CEO. The variable *Percent MBA* represents the percent of the independent directors that hold an MBA degree. Firm controls include assets, leverage-to-book ratio, return on assets, market-to-book ratio, capital expenditures to lagged PP&E, and firm returns. Industry fixed effects use the Fama–French 49 industry classification. Standard errors are clustered by firm. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Rigid	Ref	Rigid	Ref	Rigid	Ref	Rigid	Ref	Rigid	Ref
Board Size	-0.0000558 (0.00179)	-0.00579** (0.00283)							-0.0000336 (0.00218)	-0.00461 (0.00338)
Percent Independent			-0.0737*** (0.0260)	-0.126*** (0.0388)					-0.0784** (0.0355)	-0.155*** (0.0504)
Percent Pre-CEO					-0.0585*** (0.0102)	-0.0590*** (0.0155)			-0.0624*** (0.0118)	-0.0679*** (0.0184)
Percent MBA							-0.0766*** (0.0253)	-0.108*** (0.0383)	-0.0545** (0.0255)	-0.0811** (0.0401)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R ²	0.0174	0.0598	0.0182	0.0606	0.0200	0.0608	0.0241	0.0736	0.0304	0.0846
Observations	49507	49507	49507	49507	49453	49453	36115	36115	31759	31759

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