Short-Termist CEO Compensation in Speculative Markets: A Controlled Experiment*

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June 28, 2019

Abstract

In Bolton, Scheinkman, and Xiong (2006), existing shareholders use compensation contracts to encourage short-termism when stock prices are speculative, due to investor disagreement and short-sale constraints. Supporting this view, we find an exogenous removal of short-sale constraints curbs short-termist incentives as measured by longer CEO compensation duration. This effect is concentrated among stocks with high investor disagreement and short-term-oriented institutional ownership. We also find that longer CEO compensation duration leads to longer CEO investment horizon, less overinvestment, and less earnings management.

*We are grateful for the comments of Ferhat Akbas, Fred Bereskin, John Bizjak, David De Angelis, Robert DeYoung, David Dubofsky, Lee Dunham, Ben Foster, Stuart Gillan, Mina Glambosky, Harrison Hong, Julie Huang, Randy Jorgensen, Paul Koch, Jiacui Li, Tse-Chun Lin, Tingting Liu, Alexander Ljungqvist, Felix Meschke, Sébastien Michenaud, Vassil Mihov, Charlie Moyer, Lars Oxelheim, Chris Stivers, Zexi Wang, Kenneth Washer, Jide Wintoki, Wei Xiong, and seminar participants and discussants at the 2018 CICF, MFA, AsianFA, SFA, TFA, 2017 SFM, Paris Financial Management Conference, Creighton University, Fudan University, National Chiao Tung University, National Dong Hwa University, the University of Dayton, the University of Kansas, and the University of Louisville. We thank Vivian Fang and Chao Jiang for data sharing. The views expressed in the research do not necessarily reflect the position of the Federal Reserve Bank of Richmond or the Federal Reserve System. Chang acknowledges research support from the Ministry of Science and Technology, R.O.C. Taiwan (106-2410-H-002-043-MY2, 107-3017-F-002-004), and the Ministry of Education (108L900202).

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1. Introduction

Corporate short-termism, or the tendency of firms to sacrifice long-term value for short-term performance, has been a focal point of debates among academics, practitioners, and policy makers over the past several decades. During the 1980s merger wave, evidence suggests that firms distorted earnings to fend off takeover threats (Stein, 1988; Erickson and Wang, 1999). During the dot-com bubble in the early 2000s, the media reported that insiders had sold shares before stock prices crashed.[1] More recently, there are again concerns over firms engaging in excessive share repurchases to meet earnings targets at the expense of long-term investments (Hribar, Jenkins, and Johnson, 2006; Almeida, Fos, and Kronlund, 2016; Edmans, Fang, and Huang, 2018).

One can make two broad observations from the existing literature. First, extreme episodes of corporate short-termism coincided with periods of high asset market speculation (Bolton, Scheinkman, and Xiong, 2005). For example, in July 2007, on the brink of the recent financial crisis, the CEO of Citibank reportedly questioned the enormous liquidity and valuations in the market, but stated that "as long as the music is playing, you've got to get up and dance."[2] Second, anecdotal evidence suggests that short-termism may in fact reflect shareholders' desire. For example, a Moody's Investor Service report pointed to impatient shareholders' penchant for share repurchases with high leverage deteriorated a firm's credit worthiness (Byrd, Hambly, and Watson, 2007).[3] In particular, the report pointed to famous investors such as Carl Icahn, who forced Time Warner and Motorola into share repurchase, asset sales, and spinoff programs.[4]

Against this backdrop, we test and find supporting evidence that short-termism is a result of optimal compensation contracting, through which current shareholders incentivize

[1]For example, the *Financial Times* reported that executives and directors from 25 failed U.S. companies during the dot-com bubble grossed about $3.3 billion (see *Financial Times*, 31 July 2002).

[2]https://www.reuters.com/article/financial-crisis-dancing/ex-citi-ceo-defends-dancing-quote-to-u-s-panel-idUSN0819810820100408

[3]https://www.moodys.com/sites/products/AboutMoodysRatingsAttachments/2006600000441326.pdf

[4]Similarly, Larry Fink of BlackRock, in his 2016 letter to CEOs of leading companies, also urged firms to emphasize long-term value creation to avoid the pressures of impatient shareholders (Fink, 2016).

managers to emphasize short-term stock performance in a speculative market. We design a series of tests based on the model of Bolton, Scheinkman, and Xiong (2006) (hereafter, BSX) for stock-based executive compensation. In this model, the only departure from the classical efficient contracting framework of Holmström and Tirole (1993) is to allow for a speculative stock market, due to investor disagreement. In a stock market with short-sale constraints, disagreement among investors results in a speculative component in the stock price because pessimistic views are sidelined (Miller, 1977; Morris, 1996; Hong and Stein, 2007). Consequently, existing shareholders in this model design optimal equity-based compensation contracts that encourage short-term performance, in hopes of increasing the speculative component in the stock price and selling their shares to more optimistic investors in the near future (Scheinkman and Xiong, 2003).

This model yields directly testable implications related to its two key components: short-sale constraints and investor disagreement. First, we expect to observe fewer short-termist incentives in managerial compensation if constraints on short-sales are removed. Because short-selling enables the market to include pessimistic views and decreases the speculative component in stock prices, short-termism becomes less attractive to existing shareholders. The theoretical premise that short-selling promotes price efficiency and market quality can be traced back to at least the classic work of Diamond and Verrecchia (1987), and empirical studies inspired by the recent financial crisis also confirm this view (Beber and Pagano, 2013; Boehmer and Wu, 2013).

Second, when short-sale constraints are removed, firms with high investor disagreement over their fundamental values should reduce short-termist incentives in managerial compensation more than firms with low investor disagreement. Since firms with high investor disagreement have a relatively larger speculative component in their stock prices (Diether, Malloy, and Scherbina, 2002; Chen, Hong, and Stein, 2001), there exist high incentives for manipulating stock prices with short-termist incentives. Therefore, the marginal effect of short-selling on short-termism for these firms is high. On the contrary, if investors generally

have a consistent view with respect to a firm's value, then little market speculation exists from the onset and thus the binding nature of short-sale constraints is less relevant.

Testing these model implications empirically is challenging. First, due to endogeneity concerns, a correlation between a change in executive compensation short-termism and a change in short-selling activities is hard to interpret; omitted variables (e.g., negative private signals) might drive the behavior of both short-sellers and corporate insiders. Also, reverse causality can prove to be a problem, in which case it is actually the structure of executive compensation that drives short-sale activities, which is plausible given media attention on short-termism during periods of asset overvaluation. Second, one would need a measure to quantify short-term incentives in executive compensation.

Our identification strategy to address endogeneity is to exploit a randomized experiment by the Securities and Exchange Commission (SEC) during the Regulation SHO program, which relaxed the short-sale constraints for a group of pilot stocks from 2005 to 2007. Specifically, Rule 202T of Regulation SHO lifted short-sale price tests for every third stock in the Russell 3000 index, as sorted by trading volume within each stock exchange.[5] Recent studies document an increase in short-selling activities for these Regulation SHO pilot firms, speaking to the binding nature and economic significance of short-sale price tests (Diether, Lee, and Werner, 2009; Grullon, Michenaud, and Weston, 2015). Importantly, the Regulation SHO pilot program represents an exogenous shock to short-sale constraints on a randomized set of firms, allowing us to address the endogenous nature of short-selling. Furthermore, the pilot program has clear beginning and ending dates, which allows us to conduct difference-in-difference tests (hereafter, DiD) so we may observe the effect of short-selling on compensation structure both during and after the pilot program.

To quantify the extent of short-termism in executive compensation, we construct a measure to reflect the "duration," or value-weighted average lengths, of the vesting periods in

[5]Before Regulation SHO, the NYSE restricted short-selling prices to be either above the most recent traded price, or at the most recent traded price if that price was above the most recent different price. NASDAQ required short-sale prices to be one cent above the bid price if it was below the previous bid. The SEC eliminated short-sale price tests for all exchanges after the Regulation SHO program.

each CEO's annual compensation. Following Gopalan et al. (2014), we measure CEO compensation duration (*CPD*) as the weighted average vesting periods of the different components in each CEO's annual compensation package, which includes salary, bonus, restricted stocks, and stock options. The weights are then the relative value of each component in the entire compensation package. Consistent with intuition, Gopalan et al. (2014) show that firms with more long-term projects or future growth opportunities have longer *CPD*s.[6,7]

Our DiD estimates show that pilot firms have close to 8% longer *CPD*s relative to non-pilot firms during the Regulation SHO program from 2005 to 2007, when compared to the difference in pre-program years. The economic significance is around 13% of the standard deviation of *CPD* in our sample.[8] This difference in *CPD* is not statistically significant after the program concludes, thus providing a validity check on our DiD framework. Our baseline results are consistent with BSX; i.e., in a speculative market with investor disagreement and short-sale constraints, shareholders use short-term compensation incentives to induce CEOs to focus on short-term performance. Once short-sale constraints are removed, shareholders choose to focus on long-term fundamentals.

Confirming our second model prediction, we show that the compensation duration effect in our baseline regressions is concentrated among firms with pre-existing high investor disagreement. We use two measures of investor disagreement to partition our sample: abnormal turnover (Chen, Hong, and Stein, 2001), and analyst forecast dispersion (Diether, Malloy, and Scherbina, 2002). Both measures of disagreement yield similar results. For example,

[6]Anecdotal media coverage suggets that vesting schedules and provisions have strong influence on executive behavior. For example, WhatsApp co-founder Jan Koum announced his intended departure from Facebook in April, 2018. However, he continued to show up at Facebook after the announcement to ensure that his stock grants were fully vested in November, 2018.

[7]There are other measures that characterize different dimensions of CEO compensation. Two widely used correlations, *Delta* and *Vega*, measure CEO pay sensitivity to stock price performance and volatility, respectively (Coles, Daniel, and Naveen, 2006). Our objective is to quantify the time dimension in compensation incentives by explicitly accounting for the lengths of both stock and option grants' vesting schedules. Gopalan et al. (2014) show that *CPD* explains managerial behavior beyond that of *Delta* and *Vega*. In our empirical tests, we show that our results are robust to controlling for *Delta* and *Vega*.

[8]It is worth emphasizing that the 8% difference in *CPD* is due to the removal of one aspect of short-sale constraints: short-selling price tests. In practice, other short-sale constraints exist (e.g., explicit borrowing costs, institutional restrictions, etc.). For example, individual investors and mutual funds rarely short stocks (Almazan et al., 2004).

the DiD estimates of the compensation duration effect during the Regulation SHO program are more than 10% for firms with high abnormal turnover. In contrast, the DiD estimates are economically and statistically insignificant for firms with low abnormal turnover. In addition, we provide corroborating evidence by partitioning the sample by the change in investor disagreement during the Regulation SHO program. When short-sellers enter into the market, we expect a firm to lengthen their *CPD* more when there is a larger drop in investor disagreement. Indeed, for firms with larger drops in investor disagreement, we find that the difference in *CPD*s between the pilot and control firms is approximately 14% larger than the difference before Regulation SHO. On the contrary, we do not find significant results among firms with smaller drops in investor disagreement.[9]

We next explore the role of existing shareholders, who play a critical role in the model as they are the ones incentivizing CEOs to be short-termist. Large institutional shareholders not only have considerable influence over CEO compensation designs (Shleifer and Vishny, 1986; Black, 1992), but are also better monitors of corporate compensation since they typically hold larger stakes and possess greater governance expertise (Edmans, Gabaix, and Jenter, 2017). Consistent with this view, Hartzell and Starks (2003) find that higher institutional ownership leads to more incentive-compatible executive compensation designs. In other words, influential institutional shareholders align managerial compensation to their preferences. Therefore, if a firm's institutional investors mostly focus on short-term results, then a direct implication from the BSX model is that these investors will exert more short-term pressure on management to exploit market speculation.

Accordingly, we expect the marginal benefits of encouraging short-termism to drop when short-sale constraints are exogenously removed, more so for firms with more institutional investors that focus on short-term performance. Supporting this hypothesis, we find that firms with pre-existing high levels of short-term-oriented institutional investors (relative to long-term-oriented investors) have considerably higher compensation duration effect. For

[9]We thank an anonymous referee for suggesting this test.

firms with high levels of short-term-oriented institutional investors, the DiD estimate in compensation duration between the pilot and control firms is close to 19%. In contrast, we do not find a significant DiD estimate among firms with low short-term-oriented institutional investors. This evidence is consistent with a mechanism that short-term-oriented institutional shareholders use compensation contracts to encourage short-termism.

Finally, we explore the consequences of providing short-term incentives due to speculative motives. If compensation duration increases due to an exogenous shock to short-sale constraints, we should expect less short-termist CEO behavior and corporate policies. To identify these effects, we use two-stage regressions where we regress the variables of interest on CEO compensation duration, which is in turn instrumented by Regulation SHO. First and foremost, we expect CEOs to exhibit longer trading horizons in their own companies' stocks. Akbas, Jiang, and Koch (2018) construct an investment horizon measure of company insiders and find that this measure is positively correlated with CEO compensation duration. Intuitively, executives willing to accept longer compensation incentives tend to have longer investment horizons. Consistent with this finding, we find that longer compensation duration leads to longer CEO trading horizons.

Second, BSX hypothesize that existing shareholders use short-termist compensation to incentivize CEOs to invest more in wasteful "castle-in-the-air" projects in a speculative market. These inferior projects lead to additional investor disagreement and speculation, further boosting stock prices. We follow Polk and Sapienza (2009) and define firms that have above-median industry-year capital expenditures as overinvesting. As expected, we find that longer compensation duration leads to lower propensity to overinvest.

Third, we expect to observe less earnings management activities with a longer CEO compensation duration. A clear example of short-termist behavior, earnings manipulation benefits existing shareholders and potentially harms future shareholders. More generally, earnings management can manifest in the form of stock price manipulation or delayed investments such as R&D (Graham, Harvey, and Rajgopal, 2005). We examine three different

corporate decisions that are intimately linked to earnings management: repurchases, meeting analysts' forecasts, and R&D intensity.

Evidence suggests that stock repurchases lead to higher stock prices and are often used to meet analyst earnings consensus (Ikenberry, Lakonishok, and Vermaelen, 1995; Almeida, Fos, and Kronlund, 2016). Stock repurchases have become prevalent over time. By one estimate, S&P 500 firms used 54% of their earnings on share repurchase programs over the last decade (Lazonick, 2014). This trend has been linked to the growing emphasis on short-term performance in executive incentives. For instance, Edmans, Fang, and Huang (2018) find that short-term stock price concerns from vesting equity grants induce CEOs to do more value-reducing stock repurchases. Accordingly, we focus on accretive repurchases following Hribar, Jenkins, and Johnson (2006); that is, repurchases that increase a firms' EPS. Consistent with expectation, our results show that longer compensation duration leads to fewer accretive repurchases. Corroborating this result, we find that longer compensation duration also leads to less propensity for a firm's EPS to exactly match analysts' consensus, another indication of earnings management (Malmendier and Tate, 2009). Finally, we find that firms that grant their CEOs longer compensation duration also have higher R&D intensity. This is consistent with the view that CEOs will have less pressure to cut back R&D expenditures with longer incentives in their contracts.

Our findings make three contributions to the literature. First, they speak to the root causes of corporate short-termism. Various theoretical works explain managers' short-termist behavior as detrimental to current shareholders' interests by using imperfections such as manager signal jamming (Narayanan, 1985; Stein, 1989; Goldman and Slezak, 2006; Sun, 2014; Peng and Röell, 2008b, 2014), asymmetric information (Von Thadden, 1995), or heterogeneity in limits to arbitrage (Shleifer and Vishny, 1990). Our paper provides evidence for a complementary view by BSX. In this model, short-termism is consistent with the current shareholders' objective function. This view of managerial compensation reconciles the seemingly contradictory trends of improved corporate governance and persistent short-termism.

Specifically, our evidence points to market speculation and CEO compensation designs as the driving forces behind corporate short-termism. We provide further literature review on corporate short-termism and in particular the role of executive compensation designs in Section 2.

Second, our results offer potential policy implications with respect to short-termism. If we accept the optimal contracting view of managerial compensation and recognize that transient institutional investors are the driving forces, then introducing more shareholder activism, strengthening corporate governance, or even increasing institutional ownership are not ideal policy options. For instance, Cadman and Sunder (2014) show that VC-backed IPO firms use short-term incentives to boost stock prices as venture capital exits, which provides an example of institutional investors exacerbating rather than mitigating managerial short-termism. In a similar vein, Asker, Farre-Mensa, and Ljungqvist (2015) find that stock market-listed firms exhibit more short-termism than private firms, due to pressures from transient institutional shareholders. Accordingly, addressing short-termism may lie in less speculative stock prices, potential restrictions on CEOs unwinding stock holdings, or mechanisms to tie compensation incentives to the longer-term performance of company stocks.

Third, this paper contributes to the literature that explores the link between secondary financial markets and their effects on real decision-making (for a review, see Bond, Edmans, and Goldstein, 2012). Stock prices aggregate information in the secondary market and potentially guide real decisions such as corporate investments. This idea goes back to Hayak (1945) and Fama and Miller (1972). For example, stock prices can affect corporate decisions through trading between insiders and outside speculators (Fishman and Hagerty, 1992; Leland, 1992; Khanna, Slezak, and Bradley, 1994), securities issuances (Boot and Thaker, 1997; Subrahmanyam and Titman, 1999), and cross-listings (Foucault and Gehrig, 2008). In particular, our paper belongs to a strand of this literature where real decisions are affected by stock prices through a manager's contract incentives (Holmström and Tirole, 1993). In this

regard, we provide a more comprehensive review of the role of short-selling in managerial compensation and real decisions in Section 2.

The rest of the paper is organized as follows: Section 2 provides further literature review. Section 3 describes the sample, key variable definitions, and our identification strategy. Section 4 reports our tests of the effects of short-sale constraints and investor disagreement on CEO compensation duration. Section 5 provides evidence on mechanism and consequences of short-termist incentives. Section 6 concludes.

2. Literature Review

2.1. Short Selling

Our study contributes to a large body of research examining the role of short-selling in stock prices and corporate behavior.[10] Classical theoretical works suggest that short-sale constraints have an adverse effect by limiting the extent to which pessimists can express their views in prices.[11] Diamond and Verrecchia (1987) show that short-sale constraints impede the diffusion of value-relevant negative information into prices. Miller (1977) argues that investor disagreement combined with short-sale constraints lead to overpricing. Building on these models, more recent theoretical works suggest that short-sale constraints contribute to bubbles and excess volatility (Allen, Morris, and Postlewaite, 1993; Abreu and Brunnermeier, 2002, 2003), or market crashes (Hong and Stein, 2003). In particular, dynamic models that incorporate short-sale constraints and investor disagreement can jointly explain asset bubbles and excessive trading (Harrison and Kreps, 1978; Scheinkman and Xiong, 2003; Hong, Schienkman, and Xiong, 2006). Building on this idea, BSX propose a model where shareholders incentivize short-termist behavior from their CEOs to manipulate earnings and

[10]Short-sellers are typically viewed as sophisticated market participants. For example, prior research suggests that they are more informed than stock analysts (Drake, Rees, and Swanson, 2011) and insiders (Khan and Lu, 2013).

[11]A few theorists also point out the potential destabilizing role of short-selling (Allen and Gale, 1991; Bernardo and Welch, 2004).

overinvest in inferior projects.

Empirical tests have supported both the pros and cons of short-selling. Earlier works typically use short interest as a measure of how binding are the short-sale constraints and relate this to future lower stock returns (Figlewski, 1981; D'Avolio, 2002). Dechow et al. (2001) and Aitken et al. (1998) show that short-sellers take positions in stocks with high valuations that eventually mean-revert. Similarly, Jones and Lamont (2002), Chang, Cheng, and Yinghui (2007), and Beneish, Lee, and Nichols (2015) provide evidence that short-sale constraints lead to high valuations and low subsequent returns. Pownall and Simko (2005) show that short-sellers promote price discovery especially when there is a poor information environment. Providing support for a contrary proposition, Bris, Goetzmann, and Zhu (2007) find in an international sample that short-sale constraints are associated with less negative return skewness. Similarly, Battalio and Schultz (2006), Kaplan, Moskowitz, and Sensoy (2013), and Beber and Pagano (2013) find that short-sale constraints have little impact on prices.

One challenge in resolving this debate is the endogenous nature of short-selling activities. The Regulation SHO program by the SEC provides an ideal empirical setting to test the role of short-sale constraints on various aspects of the capital markets. Alexander and Peterson (2008) and Diether, Lee, and Werner (2009) both document that shorting activities of the pilot firms increase more than the control firms, suggesting that short-sale constraints are binding. Importantly, Grullon, Michenaud, and Weston (2015) show that stock prices of the Regulation SHO pilot firms underperform the control firms and this effect is permanent. This evidence supports the view that short-sale constraints impede pessimistic traders and induce asset overvaluation.

Our study takes a step further in this direction and studies the impact of Regulation SHO on compensation contract designs. When there is little room to manipulate investor disagreement and the resale option component in stock prices, we find that shareholders lengthen the time dimension in CEO contracts. In addition, this change in incentives in turn

leads to less overinvestment and earnings management. These findings are consistent with those of Fang, Huang, and Karpoff (2016), Grullon, Michenaud, and Weston (2015), and He and Tian (2016). We contribute to this literature by providing an economic mechanism to these findings.

A study closely related to ours is De Angelis, Grullon, and Michenaud (2017), who find that Regulation SHO pilot firms grant more options to their CEOs as a protection mechanism against bear raids from short sellers. While both papers study CEO compensation designs, we differ substantially over theoretical motivations and accordingly empirical variables of interest. De Angelis, Grullon, and Michenaud (2017) propose that the fear of uninformed bear raids (i.e., short-sellers artificially driving down stock prices) leads to more convexity in CEO compensation. Our focus, as predicted by the model of BSX, is instead the time dimension in CEO compensation and subsequently its influence on CEO and corporate behavior. In addition, an essential feature of our story relies on the assumption that removing short-sale constraints leads to less speculation. We provide this evidence by showing that Regulation SHO pilot firms have lower investor disagreement and trading volume during program years.

Importantly, we do not dispute that (the fear of) uninformed bear raids, another form of speculation, may impact compensation convexity (De Angelis, Grullon, and Michenaud, 2017), or investment decisions through a feedback effect (Goldstein and Guembel, 2008). While the bear raid hypothesis and BSX share a similar prediction in terms of how firm investments change when short-sale constraints are removed, the bear raid hypothesis is silent regarding investor disagreement and CEO compensation duration.[12] Finally, it is difficult to empirically pin down the existence (or the fear) of uninformed bear raids and thus challenging to completely rule out or control for this mechanism. Prior works and our evidence show that while Regulation SHO pilot firms have higher short-selling activity, they actually have lower prices, investor disagreement, and abnormal volume.

[12]Grullon, Michenaud, and Weston (2015) show that small firms in the Regulatio SHO program react to lower stock prices by cutting investment. Their interpretation of this finding is that it is consistent with *both* the bear raid hypothesis and the overvaluation hypothesis.

Finally, other recent studies investigate Regulation SHO's impact on other corporate decisions and market participants. Echoing De Angelis, Grullon, and Michenaud (2017), Li and Zhang (2015) find that pilot firms' managers reduce the precision and readability in their bad news disclosures in the hope to maintain stock price levels. He and Tian (2016) hypothesize that short-sellers mitigate managerial myopia and show that pilot firms' innovation efficiency improves. Hope, Hu, and Zhao (2017) show that auditors charge higher audit fees to the pilot firms, supposedly reacting to heightened litigation risks.

2.2. Corporate Short-Termism and Executive Compensation

Our paper is also part of an important and growing literature in corporate short-termism. In addition to the theoretical works referenced above, there is much empirical evidence suggesting important consequences of short-termism. Budish, Roin, and Williams (2015) use cancer treatment research data to show that short-termism leads to underinvestment in long-term research. Similarly, Edmans, Fang, and Lewellen (2017) and Edmans, Fang, and Huang (2018) find that corporate short-termist incentives lead to less real investments and more value-reducing actions. In their survey of financial executives, Graham, Harvey, and Rajgopal (2005) find that the majority of executives would sacrifice long-term firm values in favor of better earnings.

While there is much consensus on the existence of corporate short-termism, there is a lively debate in the empirical literature on whether equity compensation alleviates short-termism (for a review, see Edmans, Gabaix, and Jenter (2017)). Earlier studies find that managerial stock ownership prevents managers from opportunistically cutting R&D spending (Dechow and Sloan, 1991; Cheng, 2004). Related, Chen et al. (2015) show that better contractual protection of CEO compensation eases managerial myopia. On the contrary, others papers show a positive link between executive equity compensation and earnings management (Cheng and Warfield, 2005; Bergstresser and Philippon, 2006; Peng and Röell, 2008b, 2014) and financial misreporting (Burns and Kedia, 2006; Efendi, Srivastava, and

Swanson, 2007).

In our view, part of the difficulty in resolving this debate is due to the endogenous nature of executive compensation contracts. It is challenging to find variations in executive compensation contracts due to exogenous shocks. Our study contributes to this literature by exploiting an as-good-as-random Regulation SHO experiment that alleviates this concern. With this empirical approach, we attempt to shed light on the potential impact of executive compensation on corporate behavior.[13]

3. Data

3.1. Sample

On July 28, 2004, the Securities and Exchange Commission (SEC) published a list of 986 stocks that would be relieved of short-sale price tests during the Regulation SHO pilot program. To determine the firms eligible for the program, the SEC started with the 2004 Russell 3000 index constituents and excluded firms that were not listed on NYSE, Amex, or NASDAQ. The SEC further omitted firms that had IPOs or spin-offs after April 30, 2004. The remaining stocks were then sorted by their average daily dollar volume from June 2003 to May 2004 within each exchange. Every third stock on these rankings was selected as a pilot firm.[14] Our initial sample consists of 986 treatment firms and 1,970 control firms. Further restricting to firms for which we can measure CEO compensation duration (as defined below) and other firm characteristics, our sample is 353 treatment firms and 704 control firms.

Throughout the paper we include firm-year observations wherever possible. This is our

[13]A paper that shares the a similar theoretical motivation as us is Egger and Radulescu (2014). This study finds a correlation between a firm's shareholders' speculative tendency (measured by institutional shareholders' asset turnover rate) and its CEO's option vesting periods. While this correlation is consistent with BSX, it does not speak to the economic mechanisms in the model. In other words, this correlation can also be consistent with a story with no disagreement and short-sale constraints. For example, the paper's finding is also consistent with the clientele hypothesis in Hartzell and Starks (2003); i.e., institutional investors choose the type of firms with compensation structures consistent with their preferences.

[14]We appreciate Vivian Fang for sharing the Ruessell 3000 constituents and pilot firm list.

preferred sample selection method due to higher data requirements for our main dependent variable (CEO compensation duration), which is available for primarily large and mid-cap firms. Out of the 1,057 unique firms in our 9-year sample (pilot plus control firms), the average number of years a firm exists in our sample is 5.8 years and only 602 firms have at least one firm-year observation in each of the three experiment windows (defined below). This data limitation prevents us from requiring a firm's observations to show up in all three windows.

3.2. CEO Compensation Duration

The main dependent variable in this paper is CEO compensation duration (*CPD*), which is the weighted average vesting period of compensation components including salary, bonus, restricted stocks, and stock options. Specifically, we follow Gopalan et al. (2014) and calculate *CPD* for each CEO-year as follows:

$$CPD = \frac{(Salary + Bonus) \times 0 + \sum_{i=1}^{n_s} Restricted\ Stock_i \times t_i + \sum_{j=1}^{n_o} Option_j \times t_j}{Salary + Bonus + \sum_{i=1}^{n_s} Restricted\ Stock_i + \sum_{j=1}^{n_o} Option_j}, \quad (1)$$

where i and j index restricted stock grants and option grants, respectively. *Salary* and *Bonus* are the dollar values of annual salary and bonus. $Restricted\ Stock_i$ is the dollar value of restricted stock grant i with vesting period t_i (in months), and $Option_j$ is the dollar value of option grant j with vesting period t_j (in months).[15] n_s and n_o are the number of stock and option grants a CEO receives in a year.[16]

To estimate equation 1, we obtain detailed compensation data from the Incentive Lab database by Institutional Shareholder Services (ISS). This database contains detailed grant-by-grant information with respect to equity compensation, such as vesting schedules, vesting

[15]We use fiscal year-end stock prices and Black-Scholes model to estimate the values of restricted stock and option grants. In Section 4.3, we show that our empirical results are similar if we use grant-day values.

[16]Here we assume the dollar value and vesting period to be zero for each single grant if either of these variables is missing. This way we retain as much information as possible when aggregating across grants. However, in cases where all grants for a CEO have missing information on either dollar value or vesting period, we choose to drop these observations to be conservative.

periods, and fair values (Bettis et al., 2018; Huang, 2016). The sample of executives covered by the Incentive Lab comes from the S&P500 and a significant portion of the S&P400 (mid-cap firms). We report the summary statistics of *CPD* in the first row of Table 1. Over our sample years, *CPD* has an average and median of 20.60 and 21.28, respectively. The standard deviation is 12.46, showing a healthy cross-sectional variation.

3.3. Key Variable Definitions

In this section, we provide the definitions of key variables in our baseline specification. All other variable definitions used in this paper are in Appendix A.

3.3.1. Regulation SHO

We define three periods of interest for our study. The indicator *PRE* denotes firm-fiscal years before the Regulation SHO pilot program from 2001 to 2003. The second period, the three years (2005 to 2007) during which pilot firms did not have short-sale price test constraints, is denoted by the indicator variable *DURING*. We denote the post-SHO years (2009 to 2011) with an indicator variable *POST*.[17] Finally, we use an indicator variable *PILOT* to denote treatment firms in the pilot program.

3.3.2. Firm Characteristics Controls

We use data from the Center for Research in Security Prices (CRSP) and Compustat to compute all firm-year characteristic measures. *SIZE* is the natural logarithm of total assets.

[17]We follow Fang, Huang, and Karpoff (2016) and skip 2004 between pre-Regulation SHO years and during-Regulation SHO years because pilot firms were announced on July 28, 2004 and implemented on May 2, 2005. This design also takes into account the time for CEOs to re-negotiate their compensation contracts. The SEC first announced the list of pilot firms on July 28, 2004, following internal approval by the SEC board on June 23, 2004 (Grullon, Michenaud, and Weston, 2015). Therefore, the earlist time a CEO could start contract negotiation is on June 23, 2004. While the negotiation process of CEO compensation is not directly observable, Shue and Townsend (2017) find that CEO option grants are typically awarded in cycles of two years. Therefore, two years can be viewed as an upper-bound estimate of the time required to re-negotiate new compensation contracts. Importantly, the re-negotiation process is expected to be much shorter than two years given an exogenous shock to short-sale constraints. Similarly, we skip 2008 between *DURING* and *POST*.

LEV is total debt scaled by total assets. *MB* is the market-to-book ratio of firm assets. *LTASSET* is long-term asset, defined as property, plant, and equipment (PPE) plus goodwill, scaled by non-cash total assets. *R&D* is research and development expenditure divided by the book value of total assets. *SPREAD* is the average difference in a stock's daily bid and ask prices scaled by the mid-quote price in a year. *RET* is annual stock return. *VOLATILITY* is annualized stock return volatility calculated with daily stock returns during the year. *S.D. CF* is the standard deviation of the ratio of cash flows, scaled by lagged total assets over the previous five years. *S.D. SALES* is the standard deviation of a firm's annual sales growth over the previous five years.

We report the mean, median, and standard deviation of these firm characteristics in Table 1.

3.4. Identification Strategy and Validity Checks

Our identification strategy is to utilize the random assignment of pilot firms to be relieved of short-sale price test constraints. To the extent that Regulation SHO pilot firms are randomly assigned, we have an ideal setting of pilot and control firms to study changes in short-sale constraints and CEO compensation during the Regulation SHO program years, relative to the pre-Regulation SHO years. In addition, the ending time of the Regulation SHO program allows us to observe if the effects we document during the program years revert during the post-Regulation SHO years. This additional check serves as a natural validity check for our tests. Overall, this setting allows us to implement a DiD analysis. Specifically, we examine changes in *CPD* differences between the pilot and control firms both during and after the Regulation SHO program. In addition to random assignment, the validity of a DiD analysis also relies on a parallel trend assumption; i.e., in the absence of treatment, the pilot and controls groups should exhibit parallel trends.

In Table 2, we check the random assignment and parallel trends assumptions by comparing the level and growth rates of firm characteristics between our pilot and control firms

before Regulation SHO. While a number of studies verify the validity of a DiD analysis using Regulation SHO (Grullon, Michenaud, and Weston, 2015; Fang, Huang, and Karpoff, 2016), it is important to confirm this with our sample. Specifically, for our key variables of interest, we report their average levels in 2003 and average growth rates from 2001 to 2003 for the pilot and control firms, respectively. The pilot and control firms exhibit similar average levels and growth rates before Regulation SHO across all firm characteristics we consider. The two-sample difference tests are generally small in magnitude and statistically insignificant. Overall, the pre-event tests support the validity of a DiD analysis.

4. CEO Compensation Duration, Short-Sale Constraints, and Investor Disagreement

4.1. Regulation SHO's Impact on Short-Selling Activity and Investor Disagreement

Before CEO compensation duration, we first examine assumptions behind our empirical setting and BSX. First, we should observe a relatively larger increase in average short-selling activities during the Regulation SHO program for the pilot firms, compared to the control firms. This evidence will imply that short-sale constraints are indeed binding for the pilot firms and speaks to the validity of the identification strategy. Second, investor disagreement should decrease more for the pilot firms relative to the control firms during the Regulation SHO program. One crucial theoretical premise behind BSX and Scheinkman and Xiong (2003) is that short-selling prevents short-termist firms from increasing investor disagreement to manipulate stock prices. Finally, the previous two assumptions also imply that short-selling activities should increase more during the Regulation SHO program for firms with pre-existing high investor disagreement.

We test these assumptions and report the results in Table 3. Short-selling activity is mea-

sured by *SHORT RATIO*, defined as monthly short interest divided by the number of shares outstanding, in percentages. We use two investor disagreement measures: *DISPERSION* is the standard deviation in monthly I/B/E/S analysts' EPS forecasts, scaled by the mean forecast (Diether, Malloy, and Scherbina, 2002). *TURNOVER* is abnormal dollar trading value scaled by the previous one year average (Chen, Hong, and Stein, 2001; Barber and Odean, 2008).

In Panel A, we show the average short-selling activity before and during the Regulation SHO program for the pilot and control firms, respectively. While both pilot and control firms' short-selling activities increase during Regulation SHO, pilot firms see a larger increase. The last two columns show the average difference-in-difference estimates and t-statistics. As expected, pilot firms have a relatively larger increase in *SHORT RATIO* by 0.21% with a t-statistic of 2.5.[18] Panel B suggests that pilot firms, compared to the control firms, also have larger decreases in investor disagreement measures during the Regulation SHO program. For example, the DiD estimate using *DISPERSION* is -0.015 with a t-statistic of -2.22.

In Panel C, we report short-selling activities when the sample is first partitioned by investor disagreement in the pre-Regulation SHO years. Specifically, we compute the average investor disagreement in the *PRE* period for all CRSP stocks and partition our sample into those that fall into the bottom 30%, middle 40%, and top 30% investor disagreement groups. For brevity, we report results for the bottom and top groups. The results show that short-selling activities increase more for firms in the high disagreement partition. For example, *SHORT RATIO* increases by 1.7% more for the high *TURNOVER* firms than the low *TURNOVER* firms.

Overall, our results suggest that short-sale constraints are indeed binding for the Regulation SHO pilot firms and the removal of short-sale constraints decreases investor disagreement.

[18]This difference-in-difference estimate is approximately 7% (10.5%) of the mean (median) of *SHORT RATIO*.

4.2. Short-Sale Constraints and CEO Compensation Duration

We first investigate the effect of removing short-sale constraints on CEO compensation duration. It is important to first note that in BSX, both short-sale constraints and investor disagreement are necessary conditions for existing shareholders to engage in corporate short-termism. In other words, the level of *aggregate* investor disagreement during the Regulation SHO program years should be reasonably high for a change in short-sale constraints to impact average CEO compensation incentives.

In Figure 1, we plot the monthly average stock-level disagreement (in red) from 1990 to 2011, including all CRSP common stocks, except for penny shares and microcaps. Here, we measure stock-level disagreement by the standard deviation of analysts' long-term EPS growth forecasts. Figure 1 shows that investor disagreement is at a relatively elevated level around the time of Regulation SHO (in grey), compared to the 1990s. Thus, this evidence provides a validity check for testing BSX with our empirical setting.

We begin our baseline DiD analysis by running the following OLS regression on the firm-year level during the nine years of our sample period:

$$\begin{aligned} Log(CPD)_{i,t} =& \beta_0 + \beta_1 PILOT_i \times DURING_t + \beta_2 PILOT_i \times POST_t + \\ & \beta_3 PILOT_i + \mathbf{X}_{i,t}\boldsymbol{\beta} + \delta_t + \lambda_i + \epsilon_{i,t}, \end{aligned} \tag{2}$$

where δ_t are year fixed effects, λ_i are industry fixed effects and $\mathbf{X}_{i,t}$ are firm characteristics control variables.[19,20] All other variables are defined in Section 3 and Appendix A. The key coefficients of interest are β_1 and β_2. If shareholders give short-term incentives to their CEOs in a speculative market as in BSX, then we expect to observe a longer *CPD* if a firm

[19] The importance of industry affiliation in compensation has been emphasized early on in the literature (e.g., Krueger and Summers (1988), Baker, Jensen, and Murphy (1988)). Following this literature, industry fixed effects are defined by SIC three-digit codes.

[20] A Hausman test to determine the necessity to include firm fixed effects yields a p-value of 0.28, suggesting that unobservable time-invariant firm characteristics are not correlated with Regulation SHO. This test suggests that the gain of adopting a fixed effect model may not outweigh the cost of power and efficiency. In unreported tests (available upon request), we use a random effects model and obtain results consistent to our baseline regressions.

is designated as a pilot firm, relative to firms in the control group and in the pre-Regulation SHO years. Therefore, we expect to find a positive β_1. After the pilot program expires, we expect this difference-in-difference to revert, resulting in a smaller and statistically weaker β_2.

We report the OLS estimates in Table 4. In Panel A, we report our baseline specifications. In column (1) without any controls, we find that β_1 is a statistically significant 7.7%. The coefficient implies a 7.6% increase in *CPD* levels, or 13% of a standard deviation. Note that the total economic significance of short-sale constraints on *CPD* is expected to be larger because Regulation SHO only removes one aspect of short-sale constraints: short-selling price tests. Additional short-sale constraints such as explicit borrowing costs and institutional restrictions prevent individual and institutional investors from shorting stocks. Next, β_2 is statistically insignificant and considerably smaller in magnitude than β_1, which implies that the difference in *CPD* between the pilot and control firms in the *POST* period is similar to that in the *PRE* period. Finally, β_3 is statistically and economically insignificant, suggesting that pre-Regulation SHO differences in *CPD* between pilot and control firms are insignificant.

In columns (2)$\sim$(4), we follow Gopalan et al. (2014) and control for factors known to correlate with compensation duration: basic firm characteristics (*SIZE*, *MB*, *LEV*, *RET*, *SPREAD*), project duration (*LTASSET*, *R&D*), and firm risk (*VOLATILITY*, *S.D. CF*, *S.D. SALES*). There is only a minimal effect on the coefficients of interest when we control for these firm-level variables. The estimates of β_1 are generally close to 8% with t-statistics around 2.1. In addition, the signs of the coefficients in front of the firm characteristic variables are consistent with prior literature. CEO compensation duration is positively correlated with firm size, market-to-book, and R&D expenditures, but negatively related to leverage and bid-ask spread (Gopalan et al., 2014). As we would expect, firms grant compensation packages with longer duration when they have longer-term assets, greater future growth opportunities, and more R&D projects.

To better illustrate these findings, we first compute the average difference in *CPD* between the pilot and control firms for each of the three-year periods (*PRE*, *DURING*, and *POST*) in our sample. We then compute the period-to-period changes of this difference and plot it in Figure 2. This figure shows that the change in *CPD* difference during the *PRE* period is minimal. In contrast, the change in *CPD* difference in the *DURING* period is visibly large at 8%, and then reverses in the *POST* period.

Our findings support BSX. Given reasonably high aggregate investor disagreement, removing short-sale constraints alleviates the speculative component in pilot firms' stock prices and thus induces shareholders to grant longer-term incentives to their CEOs. After Regulation SHO, which resulted in the SEC eliminating short-sale price tests for all firms, the differences between the pilot and control firms significantly decrease.

4.3. Alternative Explanations and Robustness Tests

In this section, we discuss alternative explanations and continue to explore the robustness of our findings by including additional control variables. However, it is worth emphasizing that controlling for time-varying firm characteristics may in fact bias the regression estimates because the controls themselves may be affected by the empirical shock (Angrist and Pischke, 2009; Gormley and Matsa, 2011; Gormley, Matsa, and Milbourn, 2013). To the extent that the treatment and control groups are as good as randomly assigned, the preferred specification is without controls.

One alternative interpretation for the effect of Regulation SHO on corporate policies we document above is that it may simply be short-sellers' market disciplining effect on managers. In other words, short-selling provides a complementary mechanism in addition to internal corporate governance in reining in managers. Accordingly, the usual negative incentives associated with short-term compensation contracts, such as managerial myopia, are now less of a concern. This line of reasoning is broadly consistent with Fang, Huang, and Karpoff (2016). While we do not dispute the potential disciplining effects on managers

by short-sellers, this argument biases against us finding results in compensation duration. If short-selling provides an additional safeguard against managerial myopia, we should find Regulation SHO leading to *shorter* rather than longer compensation duration as we find in this paper.

On the contrary, the disciplining effect from short-selling can be muted following De Angelis, Grullon, and Michenaud (2017), where they find that Regulation SHO pilot firms convexify their CEOs' compensation contracts (i.e., more option grants) to protect them from potential bear raids. We control for this effect by including *Log(Vega)* as an additional control variable. For completeness, we also control for pay-performance sensitivity *Log(Delta)*, another important dimension in compensation structure (Coles, Daniel, and Naveen, 2006).[21]

In addition, CEO turnover may be correlated with short-selling activities, and our results may be driven by newly appointed CEOs receiving longer compensation duration. Gibbons and Murphy (1992) hypothesize that CEOs in the final years of their tenure have weak career concerns and thus choose to focus on short-term incentives. More recently, Marnovic and Varas (2019) show that the horizon problem exists even with endogenous incentives. In an empirical study, Dechow and Sloan (1991) find that CEOs spend less on R&D in the final years of their tenure. We control for CEO turnover with an indicator variable *CEO TURN* in our regressions.

We report these robustness tests in Panel B of Table 4. In column (1), we control for CEO turnover in addition to the firm characteristics control variables in Panel A. The DiD estimate of the compensation duration effect β_1 is 7.4%, similar to our baseline specifications in economic magnitude. The t-statistic is a slightly weaker 1.94. In column (2), we further

[21] In addition to controlling for *Vega*, we decompose our *CPD* measure into *CPD Stock* and *CPD Option*; i.e., value-weighted vesting periods of stock and option grants, respectively. We find that the CEO compensation duration effect we document in Table 4 is primarily due to restricted stock grants (results available upon request). The preference for using stocks rather than options as the primary tool for duration adjustment is most likely due to the adoption of FAS 123-R in 2005. Prior to FAS 123-R, firms are not required to expense at-the-money options in their financial statements, and the majority of firms granted employees such options to avoid changes (Balsam, Reitenga, and Yin, 2008; Choudhary, Rajgopal, and Venkatachalam, 2009). In particular, Hayes, Lemmon, and Qiu (2012) show that firms dramatically reduce the usage of option grants in preference for stock grants after 2005.

control for *Log(Vega)* and *Log(Delta)* and find similar results. The β_1 estimate is 7.5% with a t-statistic of 2.00.

Furthermore, an alternative approach to measure *CPD* in equation 1 is to use grant-date values instead of fiscal year-end values. Using grant-date values has the advantage of measuring the intent of shareholders on the dates of different grants throughout the year. At the same time, fiscal year-end values have the advantage of measuring the vesting periods of all grants at a specific point in time in a year. One would expect both approaches to yield similar results. Indeed, we find in column (3) that the DiD estimate β_1 is a statistically significant 9.3%. Finally, we include group-year fixed effects. This allows the pilot and control firms to have different year effects. We show the results in column (4). The DiD estimate β_1 is a stronger and statistically significant 13.4%.

We run two placebo tests to further ensure robustness. First, we randomly assign our sample firms into treatment and control groups using the number of firms in the respective groups as in Table 4. We then repeat the same DiD estimation and report the results in columns (1) and (2) of Table 5. As expected, the estimates of β_1, β_2, and β_3 are all insignificantly different from zero. For our second placebo test, we use the true pilot and and control firms but pseudo-timings of the Regulation SHO program. Although the ideal setting would be a time span of nine years that completely avoids our sample period, this is not possible because our *CPD* measure only goes as far back as 1999. Accordingly, the second placebo test defines *PRE* as 1999 to 2001, *DURING* as 2003 to 2005, and *POST* as 2007 to 2009. We report our results in columns (3) and (4) of Table 5. Again we find insignificant results for the coefficients of interest.

4.4. Investor Disagreement, Short-Sale Constraints, and CEO Compensation Duration

Next, we explore the role of investor disagreement in conjunction with that of short-sale constraints in CEO compensation incentives. Investor disagreement, along with short-sale

constraints, is one of the key necessary conditions in BSX. All else equal, the marginal effect of removing short-sale constraints should be larger among firms with higher market speculation due to investor disagreement; in other words, we should expect the effect in Table 4 to be stronger for this type of firm. Therefore, we partition our sample firms by measures of pre-Regulation SHO investor disagreement and re-run our DiD test.

Our first measure of investor disagreement is analyst forecast dispersion (*DISPERSION*). We follow Diether, Malloy, and Scherbina (2002) and use the dispersion of analysts' EPS forecasts to proxy for investor disagreement. Using this measure, Diether, Malloy, and Scherbina (2002) find that stocks with high analyst disagreement have subsequently low returns, which supports the hypothesis that prices reflect optimistic views in a market with short-sale constraints (Miller, 1977). To the extent that analysts' opinions reflect investors' views, this is a direct measure of disagreement. This measure is widely used in the disagreement literature; see, for example, Sadka and Scherbina (2007), Moeller, Schlingemann, and Stulz (2007), Berkman et al. (2009), Yu (2011), Hong and Sraer (2016), among others. Following this line of literature, we compute the monthly standard deviation of analysts' EPS forecasts, scaled by the consensus forecast to allow for cross-sectional comparisons. For each firm, we average *DISPERSION* over the five years before the Regulation SHO program. In Figure 1, we plot the average stock-level analyst dispersion for the high (in green) and low (in blue) investor disagreement partition. The plots show that there is a wide cross-sectional variation in investor disagreement, and the high disagreement group indeed consists of firms with high levels of disagreement relative to the market.

In partitioning firms into high and low investment disagreement groups, it is worth reiterating that it is the level of investor disagreement that impacts CEO compensation in BSX. Therefore, we must empirically ensure that the high investment disagreement partition indeed has high levels of disagreement. To do so, we classify our sample firms as high (low) disagreement firms if they fall above (below) the CRSP universe median. We then repeat our DiD analysis as in Table 4 for the two groups of firms, respectively.

We present our DiD regression results in columns (1) to (4) in Table 6. Focusing first on the low *DISPERSION* group in columns (1) and (2), we find that the DiD estimates β_1 for $PILOT \times DURING$ are both statistically and economically weak. For example, the β_1 coefficient in column (1) is 6.5% with a t-statistic of 1.40. For the high *DISPERSION* group in columns (3) and (4), the β_1 estimates are significantly larger at around 13%. The statistical significance is at 5% in column (3) and slightly lower at 10% in column (4).

One potential concern for an analyst-based measure of disagreement is that it captures the behavior of only one type of market participant. To address this concern, we use an alternative measure of investor disagreement: abnormal turnover (*TURNOVER*). Investor disagreement is intimately related to trading in this line of literature. Kandel and Pearson (1995) and Harris and Raviv (1993) both model investors with common information but with divergent opinions that engage in excessive trading. More closely related to our context with speculative trading, Scheinkman and Xiong (2003) propose that overconfident investors in a market with short-sale constraints actively trade with each other, leading to bubbles. Hong and Stein (1999) assume slow information diffusion between investor groups and show that this mechanism also leads to disagreement and trading. Specifically, we follow Chen, Hong, and Stein (2001) and measure disagreement by abnormal turnover. Every month, we compute the monthly stock turnover of each firm, scaled by the average in the previous two years. We compute abnormal turnover for all common stocks in the CRSP universe and take averages over the five years before Regulation SHO.

Similar to analyst dispersion, we partition our sample by abnormal turnover and re-run our baseline DiD regressions. The results are in columns (5) to (8) in Table 6. Focusing on columns (7) and (8), we find that the DiD estimates β_1 for $PILOT \times DURING$ among the high turnover firms are both statistically and economically significant. For example, the β_1 coefficient in column (7) is 11.2% with a t-statistic of 2.26. On the contrary, the low abnormal turnover counterpart specifications in columns (5) and (6) yield no result. Overall, we find supporting evidence that the effect on compensation duration from removing short-

sale constraints is stronger for firms with high investor disagreement.[22]

Alternatively, instead of using the level of investor disagreement in the pre-Regulation SHO years, we could partition our sample by the change of investor disagreement during Regulation SHO. Short-sale constraints are more binding for firms with larger drops in investor disagreement. Therefore, these firms will see a larger increase in CEO compensation duration during Regulation SHO, compared to those with lesser drops (or increases) in investor disagreement. Specifically, we partition the sample by the change in average investor disagreement from the *PRE* period to the *DURING* period and re-run the DiD regressions.[23]

We present the results in Table 7. Columns (1) to (4) use analysts' dispersion as the investor disagreement measure. The DiD estimates β_1 from the low dispersion change group in columns (1) and (2) are approximately 14% with strong statistical significance. The main coefficients of interest from the high dispersion change group are generally close to zero. The results using abnormal turnover in columns (5) to (8) yield similar patterns. The DiD estimates from the low turnover change group in columns (5) and (6) are again close to 14% while the high turnover change group does not have significant results.

5. Mechanism and Consequences

5.1. Mechanism: Short-Term-Oriented Institutional Ownership

What is the driving force behind the changes in CEO compensation duration we observe in the previous section? Presumably, the design of grants in CEO compensation packages are heavily influenced by the preferences of large institutional shareholders and blockholders

[22]While information asymmetry is not the emphasis in BSX, we discuss in Appendix B the role of information asymmetry, another factor that promotes market speculation. Using the information asymmetry measure by Pástor and Stambaugh (2003), we show that firms with pre-existing high levels of information asymmetry have stronger effects on CEO compensation duration from Regulation SHO. We present our results in Table A1.

[23]The changes in investor disagreement in the low (high) group are generally negative (positive). Using analyst dispersion, the median change of investor disagreement in the low (high) group is -0.065 (0.026). With abnormal turnover, the medians are -0.135 and 0.183, respectively.

(Hartzell and Starks, 2003; Edmans, Gabaix, and Jenter, 2017). In this section we explore the role of short-term-oriented institutional shareholders in promoting corporate short-termism. Specifically, we expect the marginal benefit of removing short-sale constraints to be stronger among firms with more short-term-oriented institutional shareholders; that is, we should observe a stronger effect on CEO compensation duration for these firms.

We first classify institutional shareholders into short-term-oriented investors and long-term-oriented investors. Bushee (1998) measures institutional investors' portfolio turnover and defines three types of institutional investors: transient, quasi-indexers, and dedicated. Transient institutional investors are short-term-oriented, while the other two types are long-term-oriented. For each firm-year, we follow this classification and measure the influence of short-term-oriented shareholders with the relative ownership between short-term-oriented institutional investors and long-term-oriented institutional investors (*STIO/LTIO*). Similar to our sub-sample tests in Section 4, we partition our sample firms by the average *STIO/LTIO* over the five years before the Regulation SHO program and re-run the DiD regressions.

We report our results in Table 8. We find that the compensation duration effect is concentrated among firms with pre-existing larger influence by short-term-oriented institutional investors. Focusing on column (3) for the sample of high *STIO/LTIO*, the β_1 estimate is 18.7% with a t-statistic of 2.74. Including firm characteristic controls yields similar economic and statistical significance. On the contrary, firms with low pre-existing levels of short-term-oriented institutional investors have insignificant coefficient estimates in front of $PILOT \times POST$ in columns (1) and (2), as expected.

Overall, we find evidence of a mechanism for the empirical results we present in Section 4. The empirical results we show here suggest that one of the driving forces behind corporate short-termism is the preference of short-term-oriented institutional shareholders. Accordingly, removing short-sale constraints induces firms dominated by short-term-oriented institutional shareholders to lengthen their CEO compensation duration more than other comparable firms.

5.2. Consequences

5.2.1. CEO Investment Horizon

If changes in compensation duration are effective, then we should see CEO behavior and corporate policies change accordingly. We first consider the effect on CEO behavior. One potential consequence of granting short-termist incentives to CEOs is the effect on the trading horizons in their own respective company stocks. Longer CEO compensation duration incentivizes CEOs to take a longer view in their own trades. In addition, CEOs willing to accept longer vesting periods tend to have longer stock trading horizons. Therefore, we expect longer compensation duration due to the removal of short-sale constraints will lead to longer CEO trading horizons.

To measure CEOs' trading horizons in their own company stocks, we use the CEO trading horizon measure by Akbas, Jiang, and Koch (2018).[24,25] Intuitively, if a CEO engages in mostly one-sided trades (e.g., all buys, or all sales), then she tends to have longer trading horizons. When a CEO has long-term goals, her trading pattern is typically persistent. For example, persistent selling most likely reflects ongoing diversification or liquidity needs from accumulated equity grants. In contrast, CEOs that trade frequently on both sides are more likely trading for short-term profits.

We measure a CEO's investment horizon in a given year with absolute annual net order flow. Annual net order flow is defined as the difference between the number of purchases and sales in a year, scaled by the total number of trades. Accordingly, absolute net order flow ranges between 0 and 1, and a CEO that only buys or only sells will have a value of 1. We follow Akbas, Jiang, and Koch (2018) and define a CEO's trading horizon, *HOR*, as the average absolute annual net order flow multiplied by -1. In other words, a CEO with the longest (shortest) trading horizon will have *HOR* equal to -1 (0).

To investigate Regulation SHO's impact on CEO trading horizon through compensation

[24]We appreciate Chao Jiang for sharing the trading horizon data.

[25]While Akbas, Jiang, and Koch (2018) examine trades by all company insiders, we focus on trades made by CEOs.

duration, we use two-stage regressions and report the second-stage results in column (1) of Table 9. Specifically, the first-stage regression is the baseline regression as in Table 4, and the second-stage regression is *HOR* on the fitted values of compensation duration. All regressions in Table 9 contain the full set of control variables as in Table 4 and are omitted for brevity. Column (1) shows that longer compensation duration leads to longer CEO trading horizons. The coefficient is -0.138 with a t-statistic of -2.56. We also report the reduced-form regression results in columns (2), where we run the DiD regressions with *HOR* as the dependent variable. The inference is consistent with its two-stage counterpart; i.e., removing short-sale constraints induces pilot firm CEOs to lengthen their trading horizons more than the control firm CEOs during the Regulation SHO program.

5.2.2. Overinvestment

In addition to compensation duration, another direct implication of BSX is that shareholders use short-termist compensation incentives to induce CEOs to devote more managerial efforts to "castle-in-the-air" projects. These projects have inferior long-term average values but have the potential to be overvalued in a speculative market with overconfident investors disagreeing among themselves. Therefore, we should observe less inefficient investments when CEO compensation duration increases due to short-selling. More broadly, this hypothesis is consistent with prior studies that find firms overinvest when stock prices are overvalued (see, among others, Morck, Shleifer, and Vishny, 1990; Gilchrist, Himmelberg, and Huberman, 2005; Polk and Sapienza, 2009).

We measure firm overinvestment following Polk and Sapienza (2009). Firm investment is defined as the sum of capital expenditure, research and development expense, and advertising expense, scaled by lagged property, plant and equipment (PPE). We define an indicator variable *OVERINVEST* that equals to one if a firm's annual investment level is above the industry-year median, and zero otherwise. Industry classifications are based on Fama-French 48 industries.

The two-stage regression results are reported in column (3). Here, we find that longer compensation duration due to the removal of short-sale constraints indeed leads to less propensity to overinvest. The second-stage coefficient is -0.976 with a t-statistic of -2.73. The reduced-form regression in column (4) yields consistent results.

5.2.3. Earnings Management

Next, we expect that longer CEO compensation duration should lead to less earnings management activities. BSX suggest that earnings management will be driven by shareholders' incentives to exploit market speculation. Similarly, Peng and Röell (2008a) show that fast-vesting equity compensation creates incentives for managers to manipulate earnings. One corporate behavior that has been linked to earnings management is stock repurchases. While stock repurchase is a form of payout to shareholders, it can also be used to manage earnings (Hribar, Jenkins, and Johnson, 2006; Almeida, Fos, and Kronlund, 2016). While the rise of activist investors over the past several decades has been credited for corporate governance improvements, they are also impatient investors who push for quick performance improvements and payout (Strine, 2010; Lazonick, 2014). In a speculative market as in BSX, managers incentivized by short-termist compensation will conduct more repurchases to manage earnings and boost stock prices (Ikenberry, Lakonishok, and Vermaelen, 1995). Closely related to our context, Edmans, Fang, and Huang (2018) find that short-term considerations in CEO compensation are linked to more stock repurchases. Accordingly, longer CEO compensation duration should lead to fewer stock repurchases for earnings management.

We first follow Hribar, Jenkins, and Johnson (2006) to determine the amount of accretive repurchases; i.e., repurchases that increase a firm's EPS. Specifically, we first compute the "as-if" EPS without repurchases following equation 3 in Hribar, Jenkins, and Johnson (2006).[26] Repurchases in a quarter are accretive if actual EPS exceeds "as-if" EPS by more than one cent. The dollar amount of quarterly repurchases are scaled by previous quarter-end

[26] "As-if" EPS is defined as $NI_t/(Shares\ Outstanding_{t-1} + 0.5 \times Shares\ Issued_t)$, where NI_t is reported quarterly earnings.

market capitalization and then averaged across four quarters to obtain an annual measure of accretive repurchase (ARP).

We report the two-stage and reduced-form regressions in columns (5) and (6) in Table 9. The second-stage coefficient implies that longer compensation duration leads to less accretive repurchases with marginal statistical significance. The reduced-form regression also implies that removing short-sale constraints leads to less accretive repurchases for the pilot firms compared to the control firms. It is worth noting that if the Regulation SHO program leads to lower stock prices for pilot firms, then firms in fact have *more* incentive to buy back cheap shares. Nevertheless, the evidence is more consistent with our prediction.

An alternative measure of earnings management is the propensity to exactly meet analysts' forecasts, or zero earnings surprises (Malmendier and Tate, 2009). We define an indicator variable EM that equals to one if a firm's EPS is identical to the median of analysts' forecasts, and zero otherwise. We report the two-stage and reduced-form regressions in columns (7) and (8) in Table 9. As expected, the second-stage results imply that longer compensation duration leads to less propensity of earnings management. In addition, the reduced-form regressions also suggest that removing short-sale constraints decreases a firm's earnings management activities.

Finally, cutting R&D expenditure has also been linked to earnings management. For example, Graham, Harvey, and Rajgopal (2005) survey financial executives and find that the majority would decrease discretionary spendings such as R&D to meet earnings targets. Bushee (1998) finds that this tendency to sacrifice R&D in favor of short-term earnings is strongest among firms with more short-term-oriented institutional shareholders. Accordingly, we expect CEOs with longer-term incentives in their compensation contracts to focus more on R&D investments.

We define R&D intensity by R&D expenditure scaled by lagged PPE. The two-stage and reduced-form regression results are in columns (9) and (10). In column (9), the second-stage coefficient shows that a longer compensation duration indeed leads to higher R&D

intensity with marginal statistical significance. The reduced-form regression in column (10) is not statistically significant though the signs of the coefficients are consistent with our expectation.

Overall, we find consistent evidence that longer CEO compensation duration leads to less earnings management activities.

6. Conclusion

In this paper, we exploit a randomized experiment to understand corporate short-termism. We design our tests around the executive compensation model of BSX. In this model, the major deviations from the fully efficient contracting environment are the existence of short-sale constraints in the stock market and of investors with divergent opinions regarding firm value. As such, existing shareholders design optimal contracts that encourage short-term stock performance, so they may hopefully sell their shares to more optimistic investors. In contrast to prior studies, which focus on conflicts of interests between current shareholders and managers, the conflict in BSX and our study is between current shareholders and future shareholders.

Our identification strategy is the implementation of Regulation SHO by the SEC that removes short-sale constraints for a randomly selected group of pilot stocks. Using a difference-in-difference approach, we show that the Regulation SHO pilot firms increase their CEO compensation duration more than the control firms during the program, and this difference is not significant after the program. Consistent with BSX, we show that this effect is stronger among firms with higher investor disagreement, which fosters market speculation. We identify a plausible mechanism that short-term-oriented institutional investors are the driving force behind our findings. In addition, we provide additional supporting evidence that pilot firms' CEOs have longer trading horizons, engage in less inefficient investments and earnings management. Overall, our findings not only support the speculative trading motivation

in BSX as one important cause for corporate short-termism, but also offer potential policy implications. The solution to the problem of short-termism may lie in better informed and less speculative stock prices.

Appendix A Additional Variable Definitions

TURNOVER Monthly dollar volume scaled by the previous 12-month average.

DISPERSION Monthly standard deviation of I/B/E/S analysts' EPS forecasts, scaled by the consensus analyst forecast.

CEO TURN Indicator variable equals to one if a firm has a change of CEO, and zero otherwise.

Log(Delta) Log of the change in dollar value of a CEO's wealth for a 1% change in stock price.

Log(Vega) Log of the change in dollar value of a CEO's wealth for a 1% change in stock return volatility.

STIO/LTIO The ratio of short-term-oriented institutional ownership to long-term-oriented institutional ownership. Institutional shareholders are classified following Bushee (1998). Transient institutional investors are short-term-oriented. Quasi-indexers and dedicated investors are long-term-oriented.

HOR Average absolute annual net order flow multiplied by -1 in the current year (Akbas, Jiang, and Koch, 2018). Annual net order flow is defined as the difference between the number of purchases and sales, scaled by the total number of trades.

OVERINVEST Indicator variable that equals to one if a firm's investment is above the industry-year median, where investment is defined as capital expenditure scaled by lagged PPE (Polk and Sapienza, 2009).

ARP Dollar amount of accretive repurchases, scaled by lagged market capitalization. Accretive repurchases are defined by the method in Hribar, Jenkins, and Johnson (2006).

EM Indicator variable that equals to one if a firm's EPS from the current fiscal year is the same as the median of all analysts' last forecasts.

Appendix B Information Asymmetry

While not the emphasis of BSX, information asymmetry also promotes market speculation and thus could play a role in the relationship between short-sale constraints and compensation duration. The smaller information gap between investors, the harder for asset bubbles to persist (Allen, Morris, and Postlewaite, 1993; Abreu and Brunnermeier, 2003). Therefore, we expect to observe the effect of removing short-sale constraints on *CPD* to be more pronounced among firms with high information asymmetry.

We measure information asymmetry by Pástor and Stambaugh's (2003) liquidity measure (γ). We follow their methodology and run the following regression for stock i in month t:

$$R^e_{i,d+1,t} = \alpha_{i,t} + \beta_{i,t} R_{i,d,t} + \gamma_{i,t} \text{sign}(R^e_{i,d,t}) \times v_{i,d,t} + \epsilon_{i,d+1,t}, \tag{3}$$

where d indexes each trading day in month t, $R_{i,d,t}$ is stock i's daily return on day d, $R^e_{i,d,t}$ is the market-adjusted daily return, and $v_{i,d,t}$ is the dollar volume. If a firm has severe information asymmetry (or high illiquidity), then one expects to observe a large contemporaneous price impact on the day with large dollar volume, and strong price reversal on the next trading day. The estimate of $\gamma_{i,t}$ in this case is expected to be a negative number with a large absolute magnitude. Firms with low information asymmetry would generally yield a γ estimate with a small absolute value.

Similar to Section 4, we first partition firms into high and low information asymmetry groups according to the CRSP universe median and rerun our DiD regressions. We present the results in Table A1. These results are consistent with our expectation. In columns (3) and (4), the DiD estimates for β_1 are positive and statistically significant for firms with low γ (high information asymmetry). On the contrary, the high γ (low information asymmetry) firms exhibit no significant effects. For example, column (3) shows that firms with low γ yield a β_1 estimate of 11.7% with a t-statistic of 2.29. The post-event DiD estimate, β_2, is again insignificant, consistent with our prior results. In column (1), the β_1 estimate

is both economically and statistically insignificant for firms with high γ (low information asymmetry).

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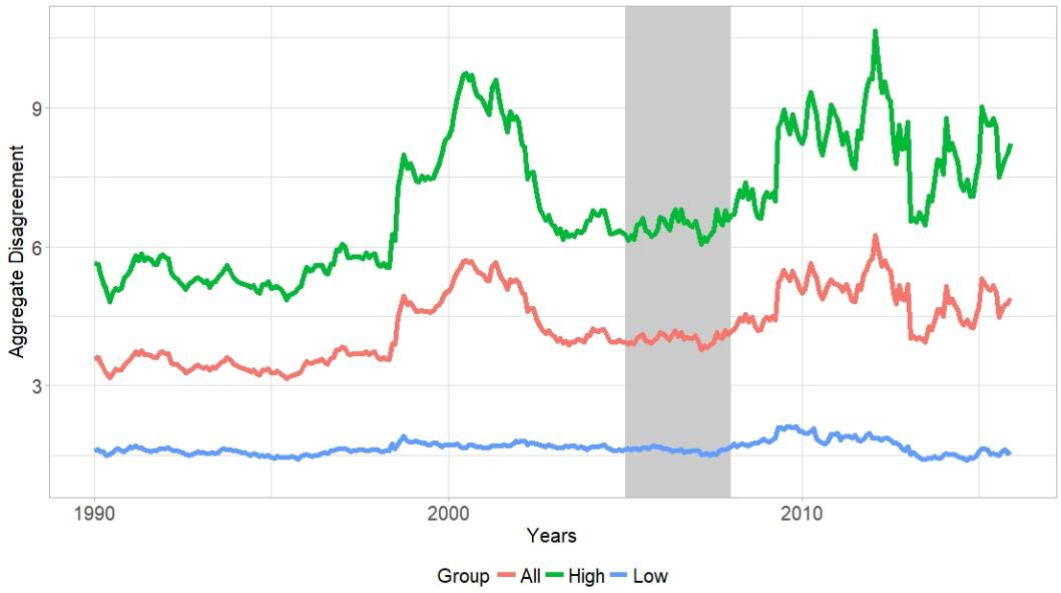

Figure 1
Aggregate Disagreement

We plot the equal-weighted monthly average stock-level disagreement from 1990 to 2011. The sample includes all CRSP common stocks excluding penny stocks (price less than five dollars) and the bottom two deciles in the monthly NYSE market capitalization deciles. Stock-level disagreement is measured by the standard deviation of long-term EPS growth forecasts by analysts. The graph plots the average disagreement of stocks for the entire sample (in red), the high disagreement sample (in green), and the low disagreement sample (in blue). The partition of High and Low disagreement groups is determined by the monthly median in stock-level disagreement. Regulation SHO program years (2005-2007) are marked in grey.

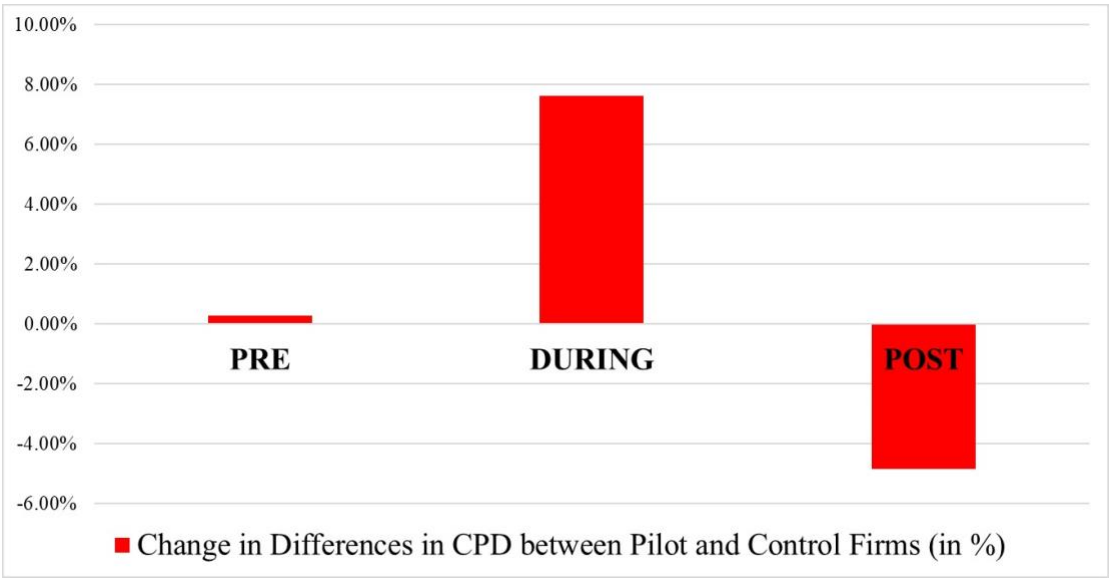

Figure 2
Change in CEO Compensation Duration: Pilot versus Control Groups
We plot the evolution of the difference in CEO compensation duration (*CPD*) between the Regulation SHO experiment pilot and control firms. We first compute the average difference in *CPD* between the pilot and control firms during four three-year periods: 1998 to 2000, *PRE* (2001-2003), *DURING* (2005-2007), and *POST* (2009-2011). We graph the period-to-period changes in these differences for the *PRE*, *DURING*, and *POST* periods.

Table 1: Summary Statistics

This table presents summary statistics of the firm characteristics for our sample. *CPD* is CEO compensation duration (in months) defined in the text and Gopalan et al. (2014). *SIZE* is the natural logarithm of total assets. *LEV* is total debt scaled by total assets. *MB* is the market-to-book ratio. *LTASSET* is property, plant, and equipment plus goodwill, scaled by noncash total assets. *R&D* is research and development expenditure divided by the book value of total assets. *ROA* is operating income before depreciation and amortization divided by the beginning of period total assets. *SPREAD* is the average daily stock bid-ask spread, scaled by the bid-ask midpoint, in a year. *VOLATILITY* is annualized stock return volatility calculated with daily stock returns during the year. *S.D. CF* is the standard deviation of the ratio of cash flows over lagged total assets over the previous five years. *S.D. SALES* is the standard deviation of the firm's annual sales growth over the previous five years. *VEGA* ($000s) is the dollar change in CEO's wealth for a 0.01 change in standard deviation of returns. *DELTA* ($000s) is the dollar change in the CEO's wealth for a 1% change in stock price. *CEO TURN* is an indicator variable that equals to one if there is a change in CEO from last year. *RET* is the annual stock return. The sample period consists of 2001-2003 (pre-pilot period), 2005-2007 (during-pilot period), and 2009-2011 (post-pilot period).

	Mean	Stdev	Min	25%	Median	75%	Max
CPD	20.60	12.46	0.00	13.38	21.28	26.97	153.84
SIZE	8.29	1.45	2.85	7.32	8.14	9.23	13.93
LEV	0.28	0.48	0.00	0.11	0.25	0.38	23.53
MB	1.92	1.79	0.02	0.91	1.41	2.31	32.94
LTASSET	0.74	0.37	0.00	0.49	0.72	0.98	2.81
R&D	0.03	0.07	0.00	0.00	0.00	0.04	1.26
ROA	0.15	0.12	-1.14	0.09	0.14	0.21	1.66
SPREAD	0.32	0.52	-0.05	0.07	0.11	0.34	8.09
VOLATILITY	2.50	1.40	0.38	1.62	2.16	2.98	24.55
S.D. CF	0.05	0.09	0.00	0.02	0.03	0.06	4.11
S.D. SALES	0.26	0.96	0.00	0.07	0.14	0.25	41.56
VEGA	174.2	271.9	0.00	34.2	90.7	204.6	3,286
DELTA	1,238	8,867	0.00	141	338	799	388,907
CEO TURN	0.11	0.32	0.00	0.00	0.00	0.00	1.00
RET	0.15	0.73	-0.98	-0.19	0.07	0.32	17.74

Table 2: Pre-Event Firm Characteristics

This table reports the average firm characteristics for the year before Regulation SHO announcement (2003) and growth rates in the pre-Regulation SHO years (2001-2003). The sample comes from the 2004 Russell 3000 index. The treatment group consists of firms designated as pilot stocks during the Regulation SHO program, and the remaining firms are classified into the control group. *CPD* is CEO pay duration (in months) defined in the text and Gopalan et al. (2014). *SIZE* is the natural logarithm of total assets. *LEV* is total debt scaled by total assets. *MB* is the market-to-book ratio. *LTASSET* is property, plant, and equipment plus goodwill, scaled by noncash total assets. *R&D* is research and development expenditure divided by the book value of total assets. *ROA* is operating income before depreciation and amortization divided by the beginning of period total assets. *SPREAD* is the average daily stock bid-ask spread, scaled by the bid-ask midpoint, in a year. *VOLATILITY* is annualized stock return volatility calculated with daily stock returns during the year. *S.D. CF* is the standard deviation of the ratio of cash flows over lagged total assets over the previous five years. *S.D. SALES* is the standard deviation of the firm's annual sales growth over the previous five years. *VEGA* ($000s) is the dollar change in CEO's wealth for a 0.01 change in standard deviation of returns. *DELTA* ($000s) is the dollar change in the CEO's wealth for a 1% change in stock price. *CEO TURN* is an indicator variable that equals to one if there is a change in CEO from last year. *RET* is the annual stock return.

	Pilot Group		Control Group					
	Level (03')	Growth Rate (01'-03')	Level (03')	Growth Rate (01'-03')	Diff	T-stat	Diff	T-stat
	(1)	(2)	(3)	(4)	(1)-(3)		(2)-(4)	
CPD	18.34	0.18	17.79	0.19	0.55	0.58	-0.01	-0.06
SIZE	8.18	0.02	8.15	0.02	0.03	0.28	-0.00	-0.25
LEV	0.29	4.06	0.38	1.74	-0.08	-0.88	2.31	0.84
MB	2.15	0.09	1.91	0.08	0.24	1.32	0.01	0.22
LTASSET	0.76	0.40	0.75	0.27	0.01	0.37	0.13	1.42
R&D	0.03	0.03	0.03	-0.02	0.00	0.35	0.05	0.71
ROA	0.16	-0.02	0.15	-0.97	0.01	1.30	0.95	0.79
SPREAD	0.39	-0.55	0.39	-0.57	0.01	0.24	0.02	0.68
VOLATILITY	2.33	-0.23	2.37	-0.25	-0.03	-0.40	0.02	0.82
S.D. CF	0.06	0.35	0.06	0.42	-0.01	-0.99	-0.07	-0.58
S.D. SALES	0.30	0.44	0.26	0.38	0.04	1.05	0.06	0.64
VEGA	204.1	3,066	199.0	40.73	5.07	0.21	3,025	1.34
DELTA	1,054	0.66	887.0	0.49	167.4	0.79	0.18	0.66
CEO TURN	0.10	-0.97	0.09	-0.95	0.01	0.38	-0.02	-0.02
RET	-0.05	-3.47	-0.05	-1.05	0.00	0.09	-2.41	-0.83

Table 3: Short-Selling and Investor Disagreement around Regulation SHO

This table reports short-selling activities and investor disagreement around Regulation SHO. In Panels A and B, we report the average of monthly short-selling activity and investor disagreement for the Regulation SHO pilot and control firms before and during the program, respectively. Short-selling activities are measured with *SHORT RATIO* (monthly short interest divided by current-month number of shares outstanding, in percentages). Investor disagreement is measured with *DISPERSION* (standard deviation in monthly I/B/E/S analyst EPS forecasts, scaled by the mean forecast) and *TURNOVER* (firm trading value scaled by previous 12-month average). In Panel C, we report the average *SHORT RATIO* when the sample is first partitioned into high and low disagreement by the CRSP universe median before the program.

Panel A: Short Selling										
	Pilot				Control				Pilot-Control	
	Before	During	Diff	T-Stat	Before	During	Diff	T-Stat	Diff-Diff	T-Stat
SHORT RATIO	3.080	4.474	1.395	22.94	3.242	4.429	1.187	23.72	0.208	2.50
Panel B: Investor Disagreement										
	Pilot				Control				Pilot-Control	
	Before	During	Diff	T-Stat	Before	During	Diff	T-Stat	Diff-Diff	T-Stat
DISPERSION	0.231	0.214	-0.017	-3.70	0.241	0.239	-0.002	-0.47	-0.015	-2.22
TURNOVER	1.923	1.483	-0.440	-13.40	1.819	1.455	-0.364	-17.40	-0.076	-2.02
Panel C: Short Selling and Investor Disagreement										
	High Disagreement (DISPERSION)				Low Disagreement (DISPERSION)				High-Low	
	Before	During	Diff	T-Stat	Before	During	Diff	T-Stat	Diff-Diff	T-Stat
SHORT RATIO	3.719	6.573	2.854	45.43	2.872	5.164	2.293	42.84	0.562	6.84
	High Disagreement (TURNOVER)				Low Disagreement (TURNOVER)				High-Low	
	Before	During	Diff	T-Stat	Before	During	Diff	T-Stat	Diff-Diff	T-Stat
SHORT RATIO	3.810	7.610	3.801	48.71	3.226	5.333	2.107	31.18	1.694	14.87

Table 4: The Effect of Pilot Program on CEO Compensation Duration

This table reports OLS results of differences in CEO compensation duration (*CPD*) between Regulation SHO pilot and control firms before, during, and after the program. *PILOT* is an indicator for a Regulation SHO pilot firm. *DURING* and *POST* are indicators for 2005-2007 and 2009-2011, respectively. Industry fixed effects are based on SIC three-digit codes. All other variables are defined as in Table 2. T-statistics are reported in parentheses. *, and ** denote significance at the 5% and 1% levels, respectively.

Panel A: Baseline Specifications				
		+Basic Controls	+Project Duration	+Firm Risks
	(1)	(2)	(3)	(4)
PILOT×DURING	0.077*	0.081*	0.081*	0.079*
	(1.98)	(2.15)	(2.13)	(2.10)
PILOT×POST	0.038	0.050	0.050	0.047
	(0.90)	(1.21)	(1.23)	(1.14)
PILOT	-0.017	-0.036	-0.035	-0.032
	(-0.56)	(-1.24)	(-1.19)	(-1.10)
SIZE		0.072**	0.074**	0.077**
		(10.29)	(10.43)	(10.62)
MB		0.048**	0.047**	0.046**
		(8.66)	(8.24)	(8.00)
LEV		-0.398	-0.039	-0.039
		(-1.07)	(-1.05)	(-1.06)
RET		-0.020	-0.020	-0.020
		(-1.73)	(-1.72)	(-1.72)
SPREAD		-0.118**	-0.120**	-0.127**
		(-5.74)	(-5.81)	(-5.93)
LTASSET			0.054	0.059
			(1.65)	(1.79)
R&D			0.196	0.160
			(1.30)	(1.05)
VOLATILITY				0.008
				(1.11)
S.D. CF				0.213*
				(2.26)
S.D. SALES				-0.009
				(-1.09)
INTERCEPT	3.027**	2.356**	2.294**	2.234**
	(10.46)	(8.04)	(7.79)	(7.54)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
No. of Obs.	5,607	5,607	5,607	5,607
Adjusted R^2	0.11	0.15	0.15	0.15

Table 4 (cont'd)

Panel B: Robustness Tests				
	+CEO Turnover	+Delta, Vega	Grant-Date CPD	Group Time Effects
	(1)	(2)	(3)	(4)
PILOT×DURING	0.074	0.075*	0.093*	0.134*
	(1.94)	(2.00)	(2.04)	(2.08)
PILOT×POST	0.059	0.052	0.050	0.093
	(1.44)	(1.29)	(0.98)	(0.75)
PILOT	-0.040	-0.055	-0.063	
	(-1.35)	(-1.88)	(-1.41)	
SIZE	0.077**	0.052**	0.060**	0.060**
	(10.12)	(6.32)	(5.55)	(7.43)
MB	0.055**	0.040**	0.034**	0.034**
	(8.81)	(6.08)	(4.32)	(5.14)
LEV	-0.074	-0.058	-0.105*	-0.105**
	(-1.79)	(-1.43)	(-2.11)	(-2.58)
RET	-0.028*	-0.035**	-0.007	-0.007
	(-2.16)	(-2.65)	(-0.29)	(-0.55)
SPREAD	-0.135**	-0.127**	-0.137**	-0.137**
	(-5.72)	(-4.89)	(-3.94)	(-5.31)
LTASSET	0.059	0.063	0.060	0.060
	(1.72)	(1.90)	(1.38)	(1.81)
R&D	0.297	0.308	0.403*	0.406*
	(1.72)	(1.82)	(2.14)	(2.39)
VOLATILITY	0.011	0.020*	0.015	0.014
	(1.31)	(2.34)	(1.44)	(1.70)
S.D. CF	0.211*	0.176	0.209	0.205*
	(2.15)	(1.88)	(1.94)	(2.20)
S.D. SALES	0.005	0.010	-0.001	-0.001
	(0.60)	(0.91)	(-0.11)	(-0.05)
CEO TURN	0.059**	0.109**	0.097**	0.096**
	(2.44)	(4.34)	(3.52)	(3.83)
Log(Delta)		0.049**	0.035**	0.035**
		(7.03)	(3.88)	(5.01)
Log(Vega)		0.003	0.003	0.003
		(1.84)	(1.19)	(1.91)
INTERCEPT	2.208**	2.174**	2.261**	2.255**
	(7.69)	(7.06)	(7.37)	(7.34)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
No. of Obs.	5,129	4,641	4,614	4,614
Adjusted R^2	0.16	0.17	0.16	0.15

Table 5: Placebo Tests

This table reports OLS results of differences in CEO compensation duration (*CPD*) between Regulation SHO pilot and control firms before, during, and after the program. In specifications (1) and (2), we use a random number generator to select the same number of firms as in the Regulation SHO pilot group. *PILOT* is an indicator for a treatment pilot firm. *DURING* and *POST* are indicators for 2005-2007 and 2009-2011, respectively. In specifications (3) and (4), we define alternative timings for the pilot program: before-treatment is 1999 to 2001, during-treatment is 2003 to 2005, and post-treatment is 2009 to 2011. All other variables are defined as in Table 2. Industry fixed effects are based on SIC three-digit codes. T-statistics are reported in parentheses. *, and ** denote significance at the 5% and 1% levels, respectively.

	Random Treatment Firms		Alternative Treatment Timing	
	(1)	(2)	(3)	(4)
PILOT×DURING	-0.053	-0.035	-0.012	-0.006
	(-1.40)	(-0.95)	(-0.29)	(-0.14)
PILOT×POST	-0.066	-0.051	0.045	0.053
	(-1.59)	(-1.27)	(1.13)	(1.34)
PILOT	0.050	0.032	0.013	-0.007
	(1.71)	(1.11)	(0.41)	(-0.24)
SIZE		0.077**		0.074**
		(10.65)		(10.17)
MB		0.046**		0.033**
		(7.98)		(7.72)
LEV		-0.039		-0.025
		(-1.04)		(-0.68)
LTASSET		0.060		0.023
		(1.80)		(0.68)
R&D		0.157		0.053
		(1.03)		(0.35)
RET		-0.020		-0.008
		(-1.70)		(-0.82)
SPREAD		-0.126**		-0.132**
		(-5.89)		(-6.78)
VOLATILITY		0.008		-0.014*
		(1.12)		(-1.99)
S.D. CF		0.212**		0.228**
		(2.24)		(2.81)
S.D. SALES		-0.010		-0.005
		(-1.12)		(-0.59)
INTERCEPT	3.036**	2.236**	3.052**	2.416**
	(10.49)	(7.53)	(9.95)	(7.72)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
No. of Obs.	5,607	5,607	6,144	6,144
Adjusted R^2	0.11	0.15	0.11	0.15

Table 6: The Effect of Investor Disagreement and Pilot Program on CEO Compensation Duration

This table reports OLS results of differences in CEO compensation duration (*CPD*) between Regulation SHO pilot and control firms before, during, and after the program. *PILOT* is an indicator for a Regulation SHO pilot firm. *DURING* and *POST* are indicators for 2005-2007 and 2009-2011, respectively. All other variables are defined as in Table 2. Firms are partitioned by their average analyst dispersion in columns (1) to (4), and abnormal turnover in columns (5) to (8). Both variables are estimated and averaged over 1999 to 2003. Abnormal turnover is the average monthly stock turnover minus the average turnover from the previous two years. Analyst dispersion is the average monthly standard deviation in analysts' EPS forecasts, scaled by the consensus forecast. Industry fixed effects are based on SIC three-digit codes. T-statistics are reported in parentheses. *, and ** denote significance at the 5% and 1% levels, respectively.

	Low DISPERSION		High DISPERSION		Low TURNOVER		High TURNOVER	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PILOT×DURING	0.065	0.080	0.137*	0.125	-0.014	-0.004	0.112*	0.105*
	(1.40)	(1.76)	(2.10)	(1.94)	(-0.23)	(-0.06)	(2.26)	(2.17)
PILOT×POST	0.069	0.080	0.018	0.029	-0.009	0.015	0.050	0.048
	(1.38)	(1.62)	(0.25)	(0.40)	(-0.14)	(0.23)	(0.93)	(0.91)
PILOT	-0.008	-0.030	-0.060	-0.068	0.083	0.046	-0.071	-0.074
	(-0.21)	(-0.85)	(-1.16)	(-1.33)	(1.69)	(0.95)	(-1.85)	(-1.95)
SIZE		0.078**		0.077 **		0.069**		0.079**
		(8.20)		(6.05)		(5.65)		(7.99)
MB		0.046**		0.037 **		0.054**		0.036**
		(6.15)		(3.85)		(4.72)		(5.09)
LEV		0.013		-0.153*		-0.147*		-0.007
		(0.26)		(-2.53)		(-2.18)		(-0.14)
LTASSET		0.113**		0.001		0.041		0.064
		(2.33)		(0.03)		(0.71)		(1.51)
R&D		0.247		-0.038		-0.033		0.279
		(1.10)		(-0.18)		(-0.12)		(1.51)
RET		-0.012		-0.027		-0.029		-0.011
		(-0.73)		(-1.57)		(-1.86)		(-0.65)
SPREAD		-0.080**		-0.115 **		-0.045		-0.175
		(-2.18)		(-4.03)		(-1.50)		(-5.46)
VOLATILITY		-0.004		0.023		-0.003		0.016
		(-0.38)		(1.93)		(-0.23)		(1.57)
S.D. CF		0.613**		0.091		0.378		0.142
		(2.78)		(0.84)		(1.77)		(1.27)
S.D. SALES		-0.004		-0.027		-0.046		-0.010
		(-0.42)		(-1.59)		(-1.06)		(-1.13)
INTERCEPT	3.108**	2.310**	3.004**	2.289 **	3.001**	2.384**	3.077**	2.287**
	(5.77)	(4.27)	(10.11)	(7.01)	(5.87)	(4.59)	(10.23)	(7.20)
Year Effect	YES	YES	YES	YES	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES	YES	YES	YES	YES
No. of Obs.	3,392	3,392	2,092	2,092	1,925	1,925	3,674	3,674
Adjusted R^2	0.14	0.17	0.12	0.16	0.15	0.18	0.13	0.17

Table 7: The Effect of Investor Disagreement Change and Pilot Program on CEO Compensation Duration

This table reports OLS results of differences in CEO compensation duration (CPD) between Regulation SHO pilot and control firms around the Regulation SHO program. *PILOT* is an indicator for a Regulation SHO pilot firm. *DURING* is an indicator variable for 2005-2007. All other variables are defined as in Table 2. Firms are partitioned by the change in average disagreement from the *PRE* period to the *DURING* period. *DISPERSION* is average monthly analyst forecast dispersion, scaled by the consensus forecast and *TURNOVER* is average monthly abnormal turnover. Industry fixed effects are based on SIC three-digit codes. T-statistics are reported in parentheses. *, and ** denote significance at the 5% and 1% levels, respectively.

	Low ΔDISPERSION		High ΔDISPERSION		Low ΔTURNOVER		High ΔTURNOVER	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PILOT×DURING	0.145**	0.132**	0.052	0.065	0.144*	0.134*	0.042	0.043
	(2.77)	(2.55)	(0.88)	(1.12)	(2.14)	(2.01)	(0.88)	(0.91)
PILOT	-0.031	-0.023	-0.040	-0.058	-0.098	-0.084	0.036	0.017
	(-0.72)	(-0.55)	(-0.85)	(-1.26)	(-1.75)	(-1.50)	(0.96)	(0.46)
SIZE		0.076**		0.051**		0.046*		0.078**
		(5.87)		(3.66)		(2.35)		(7.39)
MB		0.030**		0.038**		0.009		0.049**
		(3.05)		(3.94)		(0.83)		(5.56)
LEV		0.006		-0.055		-0.000		-0.024
		(0.09)		(-0.89)		(-0.01)		(-0.43)
LTASSET		-0.004		0.235**		0.142		0.047
		(-0.07)		(3.43)		(1.82)		(0.90)
R&D		0.589*		-0.129		0.160		0.277
		(2.01)		(-0.51)		(0.52)		(1.19)
RET		-0.049		-0.006		-0.042		0.006
		(-1.93)		(-0.22)		(-1.50)		(0.22)
SPREAD		-0.118**		-0.147**		-0.180**		-0.110**
		(-3.68)		(-4.17)		(-4.69)		(-3.70)
VOLATILITY		0.060**		0.018		0.035		0.036**
		(3.93)		(1.17)		(1.91)		(2.73)
S.D. CF		0.148		0.679*		0.417		0.078
		(1.33)		(2.06)		(1.46)		(0.71)
S.D. SALES		-0.086**		-0.005		-0.058*		-0.011
		(-2.72)		(-0.20)		(-2.23)		(-0.36)
INTERCEPT	2.845**	1.966**	2.740**	2.002**	3.095**	2.703**	2.874**	1.955**
	(7.03)	(4.61)	(27.34)	(9.81)	(5.10)	(4.29)	(7.31)	(4.81)
Year Effect	YES	YES	YES	YES	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES	YES	YES	YES	YES
No. of Obs.	2,188	2,188	1,693	1,693	1,607	1,607	2,389	2,389
Adjusted R^2	0.17	0.20	0.14	0.17	0.21	0.22	0.17	0.21

Table 8: The Effect of Short-Term-Oriented Institutional Investors and Pilot Program on CEO Compensation Duration

This table reports OLS results of differences in CEO compensation duration (CPD) between Regulation SHO pilot and control firms before, during, and after the program. *PILOT* is an indicator for a Regulation SHO pilot firm. *DURING* and *POST* are indicators for 2005-2007 and 2009-2011, respectively. All other variables are defined as in Table 2. Firms are partitioned by the ratio of short-term-oriented institutional ownership divided by long-term-oriented institutional ownership (*STIO/LTIO*), averaged over 1999 to 2003. Short-term oriented institutional ownership consists of transient investors, and long-term-oriented institutional ownership consists of dedicated and quasi-indexers, as defined by Bushee (1998). Industry fixed effects are based on SIC three-digit codes. T-statistics are reported in parentheses. *, and ** denote significance at the 5% and 1% levels, respectively.

	Low *STIO/LTIO*		High *STIO/LTIO*	
	(1)	(2)	(3)	(4)
PILOT×DURING	0.042	0.046	0.187**	0.183**
	(0.90)	(1.02)	(2.74)	(2.73)
PILOT×POST	0.028	0.039	0.134	0.133
	(0.56)	(0.78)	(1.83)	(1.85)
PILOT	0.038	0.016	-0.172**	-0.170**
	(1.07)	(0.45)	(-3.10)	(-3.07)
SIZE		0.093**		0.061**
		(10.09)		(3.79)
MB		0.060**		0.025**
		(7.16)		(3.10)
LEV		-0.062		-0.027
		(-1.16)		(-0.53)
LTASSET		0.046		0.095
		(1.10)		(1.61)
R&D		0.075		0.235
		(0.36)		(1.05)
RET		-0.010		-0.025
		(-0.53)		(-1.74)
SPREAD		-0.086**		-0.176**
		(-3.03)		(-5.42)
VOLATILITY		0.023*		-0.013
		(2.23)		(-1.16)
S.D. CF		0.389*		0.066
		(2.00)		(0.63)
S.D. SALES		-0.021		-0.003
		(-0.65)		(-0.37)**
INTERCEPT	2.453**	1.618**	3.232**	2.765**
	(11.87)	(7.18)	(11.82)	(8.63)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
No. of Obs.	3,803	3,803	1,797	1,797
Adjusted R^2	0.15	0.18	0.14	0.17

Table 9: The Effect of Pilot Program on CEO and Corporate Behavior

This table reports 2SLS and reduced-form regression results of the effect of Regulation SHO on CEO and corporate behavior before, during, and after the program. The dependent variables are defined as follows: *HOR* is the average absolute annual net order flow by a company's CEO in a year, multiplied by -1. *OVERINVEST* is an indicator variable that equals one if a firm's investment is above the industry median, where investment is defined as capital expenditure scaled by lagged PPE. *ARP* is the dollar amount of accretive repurchases, scaled by lagged market capitalization. Accretive repurchases are defined by the method in Hribar, Jenkins, and Johnson (2006). *EM* is an indicator variable that equals one if a firm's EPS from the current fiscal year is the same as the median of all analysts' last forecasts. *RD* is the average R&D expenditure scaled by lagged PPE. For each dependent variable, we first report the 2SLS regression results, followed by reduced-form regression results, respectively. *PILOT* is an indicator for a Regulation SHO pilot firm. *DURING* and *POST* are indicators for 2005-2007 and 2009-2011, respectively. For all specifications, we include the full set of control variables as in Table 4. Industry fixed effects are based on SIC three-digit codes. T-statistics are reported in parentheses. *, and ** denote significance at the 5% and 1% levels, respectively.

Dependent Variable	*HOR*		*OVERINVEST*		*ARP*	
	(1)	(2)	(3)	(4)	(5)	(6)
Log(CPD) (fitted)	-0.138*		-0.976*		-0.050	
	(-2.56)		(-2.73)		(-1.69)	
PILOT×DURING		-0.021*		-0.054*		-0.004**
		(-2.12)		(-3.00)		(-3.90)
PILOT×POST		-0.011		-0.012		-0.003*
		(-0.92)		(-0.46)		(-2.03)
PILOT		0.015		-0.015		0.001
		(1.49)		(-0.70)		(1.62)
Year Effect	YES	YES	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
No. of Obs.	2,387	2,387	5,467	5,467	2,423	2,423

Dependent Variable	*EM*		*RD*	
	(7)	(8)	(9)	(10)
Log(CPD) (fitted)	-0.494*		0.321	
	(-2.61)		(1.90)	
PILOT×DURING		-0.058**		0.021
		(-3.09)		(1.42)
PILOT×POST		-0.029		0.004
		(-1.41)		(0.24)
PILOT		0.045**		0.007
		(3.09)		(0.61)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
Controls	YES	YES	YES	YES
No. of Obs.	5,485	5,485	5,569	5,569

Table A1: The Effect of Asymmetric Information and Pilot Program on CEO Compensation Duration

This table reports OLS results of differences in CEO compensation duration (CPD) between Regulation SHO pilot and control firms before, during, and after the program. *PILOT* is an indicator for a treatment pilot firm. *DURING* and *POST* are indicators for 2005-2007 and 2009-2011, respectively. All other variables are defined as in Table 2. Firms are partitioned by their average asymmetric information measure (γ) in the *PRE* period, following Pastor and Stambaugh (2003). Industry fixed effects are based on SIC three-digit codes. T-statistics are reported in parentheses. *, and ** denote significance at the 5% and 1% levels, respectively.

	Low Asymmetric Information (high γ)		High Asymmetric Information (low γ)	
	(1)	(2)	(3)	(4)
PILOT×DURING	0.039	0.062	0.117*	0.102**
	(0.66)	(1.08)	(2.29)	(2.03)
PILOT×POST	0.025	0.051	0.068	0.061
	(0.39)	(0.83)	(1.22)	(1.11)
PILOT	-0.006	-0.039	-0.028	-0.028
	(-0.12)	(-0.85)	(-0.69)	(-0.69)
SIZE		0.086**		0.077**
		(6.61)		(8.32)
MB		0.062**		0.037**
		(5.96)		(5.13)
LEV		0.025		-0.075
		(0.41)		(-1.57)
LTASSET		0.069		0.074
		(1.25)		(1.69)
R&D		-0.234		0.276
		(-0.81)		(1.52)
RET		-0.031		-0.022
		(-1.55)		(-1.48)
SPREAD		-0.101**		-0.149
		(-3.24)		(-4.84)
VOLATILITY		0.002		0.016
		(0.19)		(1.64)
S.D. CF		0.526		0.155
		(1.77)		(1.56)
S.D. SALES		-0.001		-0.010
		(-0.04)		(-1.08)
INTERCEPT	2.496**	1.780**	3.011**	2.222**
	(12.14)	(7.41)	(10.54)	(7.36)
Year Effect	YES	YES	YES	YES
Industry Effect	YES	YES	YES	YES
No. of Obs.	2,384	2,384	3,217	3,217
Adjusted R^2	0.14	0.18	0.13	0.17