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The impact of short selling on dividend smoothing[☆]

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ABSTRACT

We examine the impact of stock-price formation process on firms' dividend smoothing using Regulation SHO. We find that pilot firms are more likely to increase dividends and less likely to omit them during the pilot program; however, they are more likely to decrease dividends after the program ends. These firms also smooth less and have higher adjustment speeds. Our findings are more pronounced for firms with higher information asymmetry, stronger financials, and weaker governance. In general, this study shows that financial markets tend to have a significant and long-lasting impact on dividend smoothing policy.

1. Introduction

Market frictions can cause prices to drift away from their fundamental value, thus weakening the allocational role of stock prices within financial markets (Goldstein and Guembel, 2008; Li et al., 2020) and distorting their informational role in guiding firms' financing and investment decisions. Identifying the impact of stock-price dynamics on corporate decisions can be challenging because of endogeneity and measurement concerns, and the extant literature provides inconsistent evidence.[1] To avoid these issues, we use an exogenous shock to the firm's financial environment and the stock-price formation process, namely Regulation SHO.

Chen et al. (2018) show that Regulation SHO leads to an increase in cash dividends for small firms. However, dividend increases in response to market frictions without corresponding changes to earnings could significantly influence firms' dividend smoothing behavior. An important finding in the literature is that firms prefer stable dividends, adjust them to specific targets based on earnings, and tend to smooth them to demonstrate future financial stability (Lintner, 1956; Brav et al., 2005). Firm characteristics (Michaely and Roberts, 2011; Leary and Michaely, 2011) and investors' preferences (Allen et al., 2002; Larkin et al., 2016) can influence a firm's decision to smooth dividends. However, the literature on how financial market frictions shape the distribution of corporate dividends and influence dividend smoothing and stability is limited. This paper fills this gap and explores how Regulation SHO impacts the stability of dividends and dividend smoothing behavior through the removal of short-selling restrictions and its effect on price formation.

We focus on dividend smoothing because dividends are regarded as a stronger (John and Williams, 1985; Allen, Bernardo, and Welch, 2002) and more permanent (Jagannathan et al., 2000) signal than share repurchases. Furthermore, studies show that dividend smoothing is an essential managerial goal despite it being costly to firms (Lintner, 1956; Fama and Babiak, 1968; Brav et al., 2005). However, Larkin et al. (2014) show that there is no relationship between smoothing and the stock's market value despite investors preferring dividend-paying stocks. Thus, the evidence for smoothing is mixed, and there is still much debate about why firms smooth dividends. Two of the traditional explanations for smoothing are based on signaling and agency theories. Nonetheless, the extant literature on these theories provides contrasting views on the

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[1] Authors such as Campello and Graham (2013) find that high stock prices affected financing and investing decisions during the 1990's technology bubble. Edmans et al. (2012) show that price changes have a significant impact on takeover activity. Morck et al. (1990), however, point out that the incremental impact of stock prices on investments is small after controlling for firm fundamentals. Bakke and Whited (2010) further claim that the component of stock prices related to investment does not influence investment decisions.

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influence of short-selling activity on stock prices and hence, how it could influence the distribution of payouts and dividend smoothing behavior.

On one hand, an increase in short-selling activity could discourage firms from making dividend changes and increase dividend smoothing for two reasons. First, as claimed by Saffi and Sigurdsson (2011) and Boehmer and Wu (2013), short selling improves price efficiency. Hence, more informative prices decrease information asymmetry, reducing the incentive to change dividends and generating a more stable dividend policy. Second, the literature (e.g., Karpoff and Lou, 2010; Hirshleifer et al, 2011) shows that short-selling activity facilitates earlier identification and incorporation of managerial misconduct into prices. As a result, it can reduce managerial misconduct and the incentive to divert resources from managers using dividends, leading to a more stable dividend policy.

Alternatively, an increase in short-selling activity could encourage firms to make more changes to their dividend policies and decrease dividend smoothing for two reasons. First, as the literature (e.g., Goldstein and Guembel, 2008; Goldstein et al., 2013; Lin et al., 2020) suggests, short-selling activity encourages market manipulation of prices to drive prices downward. Bushman and Pinto (2019) find that removing short-selling constraints results in more negative media coverage, and Chau et al. (2020) show that negative media leads to a drop in stock prices. To mitigate negative perceptions, managers may choose to deviate from the current dividend policy to signal that the firm is still financially stable. Furthermore, short-selling activity increases market monitoring of managers and penalizes the stock price when managers engage in misconduct (Massa et al., 2015). This increase in market pressure can exacerbate the career concerns of managers and induce managerial risk aversion, which could lead to an increase in changes to payout policy to appease shareholders and thus, a reduction in dividend smoothing.

To identify the causal effects of short-selling activity, we use Regulation SHO, which provides an exogenous shock to one third of the Russell 3000 index firms by eliminating all short-sale price tests. These affected firms are referred to as pilot firms, and the remaining two thirds of firms in the Russell 3000 index are treated as control firms. Litvak et al. (2016) point out that the Security and Exchange Commission (SEC) also removed short-sale restrictions for the largest one third of original control firms during after-hours trading. Hence, these larger control firms are not true controls and are likely to experience an increase in short-selling pressure. We follow the procedure of Litvak et al. (2016) to further divide the original control firms into true control and partly treated firms.

Our analysis proceeds in the following steps. First, we conduct preliminary tests to validate the Regulation SHO pilot program setting. We find that short interest for pilot stocks increases during the pilot program, and these results are consistent with previous studies (Alexander and Peterson, 2008; Diether et al., 2009). Next, we compare firm characteristics during the fiscal year before the announcement of the Regulation SHO pilot program and find little difference between pilot firms and either original or true control firms, whereas partly treated firms and true control firms are significantly different. Overall, these preliminary tests indicate that short interest increases during the pilot program, and although the initial selection of firms is random, the inclusion of partly treated firms could weaken the impact of Regulation SHO.

Next, we examine the dividend smoothing behavior of pilot firms relative to true controls. Firms that exhibit smoothing behavior tend to avoid changing their dividend policy (Brav et al., 2005). To obtain a more comprehensive understanding of the effect of an increase in short selling on the stability of dividends and smoothing behavior, we investigate the propensity to increase, decrease, initiate, or omit dividend payments during and after the pilot program. Our findings show that pilot firms are more likely to pay and increase dividends and less likely to omit them during the pilot program than true control firms. Importantly, pilot firms continue to pay dividends but are more likely to decrease them after the program ends, suggesting that pilot firms are more likely to change their dividend policy in response to Regulation SHO and smooth less.

We also estimate adjustment speed using Lintner's (1956) partial adjustment approach and Leary and Michaely's (2011) modified model to further examine dividend smoothing behavior. We find that, on average, pilot firms have higher speeds of adjustment relative to true control firms, indicating that they smooth less during the sample period surrounding the pilot program. These results also hold when we use total payout and for firms that repurchase shares.

To see if these changes continue to hold following the end of Regulation SHO and the implementation of revised short-selling restrictions, we repeat our tests over the 2011–2018 period and find that pilot firms have lower speeds of adjustment relative to true control firms on average. Thus, our results demonstrate that an increase in the prospect of short selling is associated with a decrease in dividend smoothing among pilot firms relative to true control firms. The literature suggests that information asymmetry and agency conflicts can influence dividend smoothing (Leary and Michaely, 2011). We conduct cross-sectional analyses using pilot and true control firms to explain the dividend changes and the lower degree of smoothing during the pilot program. We find that the impact of an increase in the prospect of short selling is more pronounced for firms with higher information asymmetry, stronger financials, and weaker governance.

Our paper adds to the growing literature on the determinants of payout policy and dividend smoothing behavior. In particular, it is related to Chen et al. (2018), who show that the level of cash dividends increases during the Regulation SHO pilot program. However, we focus on dividend smoothing and investigate whether and to what extent financial market frictions influence dividend smoothing. In addition, we use an improved sample following the procedure by Litvak et al. (2016), which allows for a cleaner test. We find that short-selling pressure has a causal effect on the dividend smoothing behavior of pilot firms, and increasing dividends are a stronger signal than maintaining smooth dividends. Our findings are also consistent with studies that suggest that firms use dividends as a signaling device (John and Williams, 1985; Miller and Rock, 1985) or to resolve agency conflicts (Jensen and Meckling, 1976; Myers, 1977).

Our paper has policy implications related to the real effects of short-sale constraints. Regulators have debated the use of short-selling bans or price tests and their effect on financial stability. The literature suggests that short-selling restrictions decrease market quality (Lecce et al., 2012; Boehmer et al., 2013). We add to the debate on short selling by illustrating that an increase in the prospect of short-selling constraints increases the propensity to change dividend policy and that firms smooth less. We believe that our results have important implications for firms, investors, regulators, and policymakers.

2. Relevant literature

2.1. Payout policy and dividend smoothing

Payout policy refers to corporate decisions involving the amount of cash that firms pay to shareholders. In 2000, firms spent over $300 billion on payouts in the form of dividends or share repurchases. This amount has constantly increased and more than doubled over the past couple of decades. Another crucial empirical finding in the extant literature is that firms smooth dividends over time. Lintner's (1956) seminal paper uses evidence from surveys and interviews with 28 public firms to show that dividend smoothing is prevalent. More recently, Brav et al. (2005) surveyed 384 financial executives and found that managers continue to care about the stability of dividends and that dividend smoothing has increased. The literature provides several explanations for why firms smooth dividends. For example, Allen et al. (2002) show that firms' managers, particularly those of firms with large institutional investors, are more reluctant to cut dividends, whereas younger or smaller firms or firms with lower dividend yield, higher earnings volatility, or lower analyst accuracy are less likely to smooth, as argued by Leary and Michaely (2011). Consequently, given the characteristics of dividends and the fact that market imperfections do exist, the choice to distribute dividends is an important corporate decision.

The literature provides three explanations of why managers pay or smooth dividends and repurchase shares. The first is related to the tax differential between dividends and capital gains (Blouin et al., 2004; Chetty and Saez, 2006). However, we focus on the other two explanations because the impact of taxation is not applicable in the context of our study.

The second explanation is that managers can use payouts to signal information about financial stability to the market when information asymmetry exists between insiders and outsiders (Bhattacharya, 1979; Miller and Rock, 1985; and John and Williams, 1985). This explanation draws on signaling theory, which contends that managers are better informed than shareholders because they are insiders and thus able to use payouts to signal a firm's future value and financial stability. Bhattacharya (1979) demonstrates that undervalued firms are able to pay dividends, whereas overvalued firms have to raise costly external funds to finance them. Miller and Rock (1985) show that firms reduce investments and increase payouts to signal higher earnings. The models by Bhattacharya (1979) and Miller and Rock (1985) treat dividends and repurchases as substitutes, whereas John and Williams (1985) argue that dividends and repurchases are not perfect substitutes and that dividends are costlier because of taxes, making dividends a stronger signal. Finally, Allen et al. (2002) show that high-quality firms prefer to use dividends rather than repurchases and smooth dividends to attract institutional shareholders.

The third explanation links to agency theory, which suggests that payout policy interacts with agency conflicts within the firm (Jensen and Meckling, 1976; Myers, 1977). Specifically, dividends can be used as a method to divert cash away from managers and toward shareholders (Easterbrook, 1984; Jensen, 1986). As a result, managers of firms that pay higher dividends and smooth more have less cash available to spend on low-value investments. Furthermore, as suggested by La Porta et al. (2000), dividends can be either a substitute or complement to other governance mechanisms. Specifically, payouts act as a substitute if firms do not need to use payouts to improve their governance in the presence of other governance mechanisms. For instance, firms with better governance, as measured by the Gompers et al. (2003) index, are associated with lower payouts (John and Knyazeva, 2006). Grinstein and Michaely (2005) find that firms with high institutional holdings pay lower dividends. Conversely, payouts are considered to be a complement to other governance mechanisms when firms with better governance are also pressured to pay dividends or repurchase shares. For example, firms with better investor protection (La Porta et al., 2000) and in more competitive industries (Grullon and Michaely, 2012) are associated with higher payouts.

2.2. Short selling and regulation SHO

Theoretically, unlike most trading strategies, the possible loss on a short sale has an infinite value. Additionally, firms are significantly more vulnerable to short selling during periods of poor market conditions. In 1938, the Great Depression prompted the SEC to implement restrictions on short selling to avoid bear raids. Then in 1994, the NASD and NASDAQ adopted their own short sale price test known as NASD rule or the bid test. The consequence of these regulations is that they have restricted short-selling activity, which has led to a great deal of controversy surrounding short selling and the questioning of the effectiveness of short-selling restrictions.

Proponents of short-selling restrictions contend that short selling negatively impacts financial stability and has resulted in many countries implementing short-selling constraints. Goldstein and Guembel (2008) show that uninhibited short-selling activity can drive stock prices downward and increase the likelihood of stock-price manipulations and bear raids. For instance, more informed short sellers used private information to their advantage to target risky banks during the 2007–2008 financial crisis (Lin et al., 2020). Furthermore, Henry and Koski (2010) suggest that manipulative short selling reduces price efficiency. The opposing stream of literature claims that short selling helps the price-discovery process (e.g., Diamond and Verrecchia, 1987). Studies by Autore et al. (2011), Frino et al. (2011), and Boehmer et al. (2013) show that short-selling bans decrease various measures of market quality. Finally, short selling can help uncover firms' fraudulent activity or misconduct (Karpoff and Lou, 2010; Fang et al., 2016; Chen and Wu, 2021).

In response to the debate concerning the short-selling ban, the SEC announced a pilot program in July 2004, known as Rule 202 T of Regulation SHO, to promote research on short-sale price tests. To create the pilot group, the 2004 Russell 3000 index stocks were ranked by trading volume within each exchange and every third stock was selected. For these pilot stocks, all short-sale price tests were removed from May 2, 2005 to August 6, 2007, after which the short-sale price test restrictions were removed for all exchange-listed stocks.

Several studies have used Regulation SHO to examine the impact of short-selling restrictions on corporate decisions, such as bond issues (Kecskés et al., 2012), corporate innovation (He and Tian, 2014), disclosure practices (Li and Zhang, 2015), equity incentives (De Angelis et al., 2017) and earnings management (Fang et al., 2016). More recently, other studies have examined the effect of Regulation SHO on CEO pay (Lin et al., 2019), the options market (Chen et al., 2020), and corporate social responsibility (Jia et al., 2020). An essential aspect of these studies is that they rely on the notion that Regulation SHO is an exogenous event, which enables them to identify the effect of short selling on these firms' activities. The fact that many firms' executives were publicly opposed to this regulatory change is offered as evidence of the regulation's exogeneity.

2.3. Potential impact of regulation SHO on dividend smoothing

The enactment of the Regulation SHO pilot program has increased short-selling pressure for pilot firms through the elimination of short-selling restrictions (SEC, 2007). The increase in the prospect of short selling could significantly impact firms' payout policy and dividend smoothing. As discussed, the literature provides three explanations for firms' payout policies. In this section, we present the potential impact of an increase in the prospect of short selling through the lens of two of the aforementioned theoretical explanations, namely signaling theory and agency-based explanations.

First, signaling theory points out that managers are incentivized to use payouts to signal a firm's future financial stability when information asymmetry exists (Bhattacharya, 1979; Miller and Rock, 1985). The extant literature suggests that short selling can influence the incentive to signal by using payouts in contrasting ways. On the one hand, as argued by Diamond and Verrecchia (1987), the speed of price adjustment to private information increases when short-selling restrictions are relaxed. Saffi and Sigurdsson (2011) and Bohemer and Wu (2013) provide empirical support that short selling increases price efficiency. These studies jointly suggest that short-selling activity generates more informative prices, decreasing the incentive to convey inside information using payouts. Therefore, an increase in the prospect of short selling should discourage firms from making large dividend changes and smooth more.

On the other hand, Henry and Koski (2010) show that manipulative short selling reduces price efficiency. Additionally, short-selling activity encourages uninformed bear raids, which can drive stock prices downward (Goldstein and Guembel, 2008). Subsequently, investors who do not know about this regulation change may interpret price decreases as poor firm performance. Therefore, managers could use payouts to signal the firm's true quality and lessen negative perceptions from price distortions. Consequently, the increase in the prospect of short selling should lead to firms making significant changes to dividend policies and decrease dividend smoothing.

Second, agency-based explanations argue that payouts are used to limit the amount of resources available to managers to reduce agency conflicts due to potential mismanagement of firm resources (Easterbrook, 1984; Jensen, 1986). The literature shows that short sellers are informed traders who can identify and incorporate outcomes of mismanagement such as financial misconduct (Karpoff and Lou, 2010) and accrual anomalies (Hirshleifer et al., 2011) into prices. Moreover, short selling can reduce bad managerial behavior, such as earnings management and fraud (Fang et al., 2016; Chen and Wu, 2021). Therefore, to the extent that short-selling activity decreases the need to mitigate potential managerial misconduct using payouts, an increase in the likelihood of short-selling activity should reduce the incentive to make changes to dividend policies and generate smooth dividends.

Nonetheless, despite the possible reduction in managerial misconduct, the increase in short-selling activity can induce managerial risk aversion. Studies, including those by Desai et al. (2006) and Massa et al. (2015), show that short selling increases market monitoring of managers and penalizes stock prices for managerial misconduct. This increase in disciplinary pressure from the market, along with price distortions, can intensify managers' career concerns. Graham et al. (2005) find that managers facing career risks are more likely to focus on short-term and less risky projects. Hence, risk-averse managers may prefer to pay dividends or repurchase shares instead of undertaking risky investments that the market could interpret as overinvestment. These arguments suggest that an increase in the prospect of short-selling activity should encourage firms to change their dividend policies and smooth less.

Concerning the choice of payout method, John and Williams (1985) and Allen et al. (2002) show that dividends are a costlier and hence stronger signal. Furthermore, dividends are regarded as the more permanent payout method, whereas repurchases are more flexible (Jagannathan et al., 2000), which makes them less effective at reducing persistent agency conflicts. Given these characteristics of dividends and repurchases, firms with greater information asymmetry and more agency problems should prefer dividends over share repurchases. Thus, we expect the impact of an increase in the prospect of short selling to be more pronounced for dividends than repurchases.

In sum, if the prospect of short selling improves price efficiency and reduces agency conflicts, then pilot firms are more likely to smooth dividends. However, if the prospect of short selling increases price distortions and encourages managerial risk aversion, then firms are less likely to smooth dividends. In addition, given the characteristics of dividends and repurchases, the impact of the prospect of short selling should have a more pronounced effect on dividend payouts compared to share repurchases.

3. Sample and variable construction

3.1. Data sources and study sample

We use data from several sources. To identify pilot firms, we use the list of firms posted by the SEC on July 28, 2004, whereas we obtain financial and accounting data from Compustat, institutional ownership data from the Thomson 13 F database, and analyst data from the Institutional Brokers' Estimate System (I/B/E/S).[2] We examine the period 2001–2003 (inclusive) and 2005–2010 (inclusive). Following Fang, Huang, and Karpoff (2016), we omit 2004 because the pilot firms were announced during that year, although the Regulation SHO pilot program was not in effect.

[2] SEC's list is available on SEC's website (https://www.sec.gov/rules/other/34–50104.htm).

3.2. Dividend smoothing measures

We are interested in dividend smoothing. Specifically, we estimate the propensity to pay, initiate, increase, omit, or cut dividends. We identify firms that pay dividends if their dividends are greater than zero during the fiscal year *t*. The probability of paying dividends, *P(Dividends)*, is one if a firm pays dividends and zero otherwise. We follow Michaely and Roberts (2012) to define the propensity to initiate, increase, omit and decrease. The probability of initiating dividends, *P (Initiate)*, is one if a firm has a non-zero dividend payment in year $t-1$ and zero dividend payment in year *t* and zero otherwise. The probability of increasing dividends, *P(Increase)*, is one if the level of dividend payment in year *t* is greater than year *t - 1* and zero otherwise. The probability of omitting dividends, *P(Omit)*, is one if a firm has a zero dividend payment in year *t - 1* and a non-zero dividend payment in year *t*. *P (Decrease)* is one if the level of dividend payment in year *t* is less than year *t - 1* and zero otherwise.

For supplemental analysis, we use share repurchases and total payout as measures of payouts. We identify firms that repurchase shares if the difference between stock repurchases and preferred shares outstanding is strictly greater than zero (Grullon and Michaely, 2002). The probability of repurchasing shares, *P(Repurchases)*, is one if a firm repurchases shares and zero otherwise. The probability of total payout, *P (TotalPayout)*, is one if a firm either pays dividends or repurchases shares and zero otherwise.

3.3. SHO regulation pilot program

We use the SEC's Regulation SHO pilot program as a natural quasi-experiment. In the list published by the SEC, 986 pilot firms are identified, and the remaining firms are control or non-pilot firms. However, the SEC also removed short-sale restrictions for the largest one third of original control firms after the initial randomization. Litvak et al. (2016) point out that these larger control firms are not true controls, as they were subjected to short-selling pressure during after-hours trading (4:15 pm ET until the opening of the next trading day). Following Litvak et al. (2016), we further divide the original control firms into true controls and partly treated firms based on their market capitalization. Finally, we exclude firms in the financial services (SIC 6000–6999) and utilities (SIC 4900–4949) industries because regulatory requirements are different for these firms. After merging with Compustat, our sample consists of 639 pilot firms, 397 partly treated firms, and 872 true control firms. Our final sample consists of 442 pilot firms, 322 partly treated firms, and 505 true control firms with the requisite data for the variables of interest from 2001 to 2003 (inclusive) and 2005–2010 (inclusive).

3.4. Treatment and time indicator variables

We construct indicator variables to identify firm and time effects in our empirical specification. The indicator variable, *Pilot*, is one if a firm was selected as a pilot firm and zero otherwise. Next, we define three equal-length periods as follows: *Pre-PilotProgram*, which includes firms whose fiscal year-end falls between 2001 and 2003 (inclusive); *During-PilotProgram*, which includes firms whose fiscal year-end falls between 2005 and 2007 (inclusive); and *Post-PilotProgram*, which includes firms whose fiscal year-end falls between 2008 and 2010 (inclusive). We then construct indicator variables to identify each period. *Pre* equals one if the firm's fiscal year-end is in the *Pre-PilotProgram* period, *During* equals one if the firm's fiscal year-end is in the *During-PilotProgram* period, and *Post* equals one if the firm's fiscal year-end is in the *Post-PilotProgram* period.

3.5. Control variables and fixed effects

Following the literature on payout policy (see, e.g., Fama and French, 2001; DeAngelo et al., 2004; Chen et al., 2018), we control for

Table 1
Summary statistics and univariate comparison of pilot and non-pilot firms. This table reports summary statistics and univariate comparisons of key variables used in the analysis. Panel A reports the summary statistics of firm characteristics for the full sample. Panel B compares firm characteristics between the pilot, partly treated and true control firms during the fiscal year (2003) immediately before the announcement of the pilot program. Panel C compares daily short selling activity for firms listed on the NASDAQ exchange. Panel D compares daily short selling activity for firms listed on the NYSE. Variables are defined in Appendix A. *** ,**, and * denote the significance at the 1 %, 5 % and 10 % levels respectively.

Panel A: Summary statistics

	N	Mean	SD	Min	Max
Variables	(1)	(2)	(3)	(4)	(5)
Dividends	14,790	75.53	517.10	0.000	36,968
Repurchases	14,790	134.25	860.71	0.000	35,734
P(Dividends)	14,790	0.365	0.481	0.000	1.000
P(Repurchases)	14,790	0.474	0.499	0.000	1.000
P(TotalPayout)	14,790	0.609	0.488	0.000	1.000
Income	14,676	372.10	1731	-14,760	59,351
Size	14,748	4325	16,337	0.271	476,078
Market-to-Book	14,492	3.002	3.714	-7.569	23.33
Leverage	14,680	0.216	0.248	0.000	4.910
Volatility of FCF	14,790	219.80	761.80	0.345	18,824

Panel B: Comparison of pilot, partly treated and true control firms during fiscal year 2003

	True Controls		Partly Treated Pilot				Differences (T-Stat)		
	N	Mean	N	Mean	N	Mean	Original Controls vs. Pilot	True Controls vs. Partly Treated	True Controls vs. Pilot (ln(mrktcap) < 7.8)
Variables	(1)	(2)	(3)	(4)	(5)	(6)	[(2)+ (4)]-(6)	(2) - (4)	(2) - (6)
Dividends	866	3.328	397	139.7	632	49.05	-3.022	-131.2 ***	-0.610
Repurchases	866	5.539	397	146.3	632	73.99	-24.39	-135.1 ***	-2.457
TotalPayout	866	8.867	397	285.9	632	123.0	-27.41	-266.3 ***	-3.067
P(Dividends)	866	0.223	397	0.496	632	0.340	-0.031	-0.272 ***	-0.042
P(Repurchases)	866	0.322	397	0.526	632	0.392	-0.007	-0.211 ***	-0.045
P(TotalPayout)	866	0.421	397	0.725	632	0.546	-0.029	-0.310 ***	-0.075 **
Income	863	24.88	397	792.7	630	274.8	-8.794	-741.8 ***	-18.21 ***
Size	865	591.6	397	10,090	632	3143	426.6	-9165 ***	-141.7
Market-to-Book	842	3.290	394	3.578	624	3.498	-0.117	-0.288	0.075
Leverage	862	0.187	394	0.249	631	0.202	0.005	-0.063 ***	-0.012
Volatility of FCF	866	48.03	397	529.5	632	206.4	-7.463	-460.9 ***	-4.974

Panel C: Impact of Regulation SHO on daily short sales for NASDAQ listed stocks

	True Controls	Partly Treated	Pilot	Differences (T-Stat)		
	Mean	Mean	Mean	Original Controls vs. Pilot	True Controls vs. Partly Treated	True Controls vs. Pilot
Variables	(1)	(2)	(3)	[(1) + (2)] - (3)	(1) - (2)	(1) - (2)
Short Volume *(1000 s)*	49.23	471.42	114.03	4.280	-422.2 ***	-64.79 * **
Number of Trades	47.02	378.22	96.77	4.180 **	-331.2 ***	-49.75 * **
Average Short Size	1068	1403	1034	101.0 ***	-334.3 ***	33.89 *
ShortVol/OutShares *(%)*	0.090	0.110	0.100	-0.001	-0.016 ***	-0.006 * **
ShortVol/TotVol *(%)*	7.800	7.410	7.820	-0.024	0.390 ***	-0.022

Panel D: Impact of Regulation SHO on daily short sales for NYSE listed stocks

	True Controls	Partly Treated	Pilot	Differences (T-Stat)		
	Mean	Mean	Mean	Original Controls vs. Pilot	True Controls vs. Partly Treated	True Controls vs. Pilot
Variables	(1)	(2)	(3)	[(1) + (2)] - (3)	(1) - (2)	(1) - (2)
Short Volume *(1000 s)*	26.58	165.80	116.71	-14.85 ***	-139.2 ***	-90.13 ***
Number of Trades	50.90	252.66	241.85	-80.75 ***	-201.8 ***	-190.9 ***
Average Short Size	756.05	725.86	665.02	83.95 ***	30.19 *	91.02 ***
ShortVol/OutShares *(%)*	0.051	0.047	0.060	-0.006 ***	0.004 ***	-0.009 ***
ShortVol/TotVol *(%)*	4.580	4.660	5.440	-0.715 ***	-0.082 **	-0.860 ***

income, size, market-to-book ratio, leverage, and volatility of cash flows in our regression specifications. Income is the difference between EBITDA and capital expenditures, size is the book value of total assets, leverage is the book value of debt divided by the book value of total assets, market-to-book ratio is the market value of equity divided by the book value of equity, and volatility of free cash flows is the standard deviation of income. We also include year fixed effects to control for time series trends and industry fixed effects to control for time-invariant differences across industries in some specifications.

4. Methodology and descriptive statistics

4.1. Empirical model

We use a difference-in-differences approach to investigate the impact of an increase in short selling pressure on dividend changes. The difference-in-differences approach is a popular research design for identifying causal relationships by comparing the differences before and after the treatment for groups impacted by a treatment and groups not impacted by the treatment (Bertrand et al., 2004). Regulation SHO provides us with an exogenous shock that we use as the treatment effect. The pilot firms (referred to as pilot firms in the analysis) are the treated group, whereas the remaining two thirds of the firms in the Russell 3000 index (referred to as non-pilot firms) are the control group. Following Litvak et al. (2016), the control group is further divided into partly treated and true control firms.

We examine the impact of an increase in short selling activity on dividend changes using the following model:

$$P(DividendChange)_{ijt} = \alpha_t + \theta_j + \beta_0 + \beta_1 Pilot_i + \beta_2 Pilot_i * During_t + \beta_3 Pilot_i * Post_t + \gamma X_{ijt} + \varepsilon_{ijt}, \tag{1}$$

where i indexes firms, t indexes year, α_t is an indicator variable that accounts for year fixed effects, and θ_j is an indicator variable that accounts for industry fixed effects based on the Fama-French 48 Industry Classification. The dependent variable, *P(DividendChange)*, is the probability of firm i paying, increasing, initiating, omitting, or decreasing dividends during year t, as defined in Section 3.2; X is a vector of control variables, namely, income, size, market-to-book ratio, leverage, and volatility of free cash flow, as defined in Section 3.5. Finally, *Pilot*, *During*, and *Post* are indicator variables as defined in Section 3.4. All continuous variables are winsorized at the 1% and 99% levels to avoid the influence of extreme values. Lastly, we cluster standard errors by both firm and year using two-way clustering, which allows us to account for potential correlation among error terms both within firms and across time (Cameron et al., 2011).

To investigate firms' smoothing behavior, we use Lintner's (1956) partial adjustment approach and Leary and Michaely's (2011) modified model. Our variable of interest is the speed of adjustment which represents the response of firms' dividend policies to transitory shocks. Lintner (1956) estimates adjustment speed using the following model:

$$\Delta Dividend_{it} = Dividend_{it} - Dividends_{it-1}$$

$$= \alpha + \lambda\left(Dividends^*_{it} - Dividends_{it-1}\right) + \epsilon_{it}, \tag{2}$$

where $Dividends^*_{it} = TPR * Earnings$ and TPR is the target payout ratio, which represents what the level of dividends should be as a fraction of earnings. Substituting this expression for $Dividends^*_{it}$ in Eq. (2) leads to the following equation:

$$\Delta Dividend_{it} = \alpha_i + \beta_1 Dividends_{it-1} + \beta_2 Earnings_{it} + \epsilon_{it}, \tag{3}$$

where $\Delta Dividend$ is the change in dividend for firm i from year t - 1 to t and each variable is scaled by common shares outstanding to control for size effects following Fama and Babiak (1968). The speed of adjustment and target payout ratios are estimated as $-\widehat{\beta_1}$ and $\widehat{-\beta_1}/\widehat{\beta_2}$, respectively.

Lintner's (1956) model is subject to small-sample bias due to our study's sample size. Additionally, survey evidence by Brav et al. (2005) indicates that CFOs in the more recent time period are less likely to have a target payout ratio than in Lintner's time period. To correct for these issues, Leary and Michaely (2011) develop a two-step procedure to estimate adjustment speed. First, the target payout ratio is measured as the firm's median payout ratio over the sample period. Then, the deviation (*dev*) from this target ratio is measured for each period, and adjustment speed is estimated using the following model:

$$\Delta Dividend_{it} = \alpha_i + \beta_1 dev_{it} + \epsilon_{it}, \tag{4}$$

where $dev_{it} = TPR * Earnings - Dividends_{it-1}$ and adjustment speed is estimated as $\widehat{\beta_1}$..

4.2. Summary statistics

We report summary statistics of the main variables used in our analysis in Panel A of Table 1. We find that 36.5% of firms pay dividends, 47.4% of firms repurchase shares, and 60.9% of firms either pay dividends or repurchase shares. These numbers are consistent with those of previous studies. For instance, Farre-Mensa et al. (2014) find that about 20% of firms paid dividends and 35% of firms repurchase shares in 2000, and these percentages increase to 35% and 45% in 2012, respectively. Additionally, our data show that, on average, firms pay approximately \$75 million in dividends and \$134 million in repurchases. The summary statistics for the control variables are similar to those of Chen et al. (2018), who use the same time period as our study.

Next, we examine the propensity to pay dividends during the time periods surrounding Regulation SHO for pilot and true control firms. Fig. 1 shows the difference between the fraction of pilot and true control firms paying dividends, indicating that the propensity to pay dividends increases more sharply for pilot firms than true control firms during the pilot program and increases further when the pilot program ends. Fig. 2 depicts the difference in the fraction of pilot and true control firms making changes to their dividend policies through initiations, increases, omissions, and decreases. The observed patterns indicate that pilot firms are more likely to increase dividends during the pilot program but are more likely to decrease dividends after the pilot program ends. The propensity to initiate or omit dividends is similar for pilot and true control firms throughout the sample period. Fig. 3 displays the difference between the fraction of pilot and true control firms repurchasing shares, showing that pilot firms are more likely to repurchase shares during the pilot program. Fig. 4 displays the difference between the fractions of firms paying dividends or repurchasing shares and reveals that pilot firms are more likely to pay dividends or repurchase shares during the pilot program. Although these graphs do not provide conclusive findings, they suggest that the increase in the prospect of short selling during the Regulation SHO pilot program impacts dividends and repurchases.

4.3. Univariate analysis

To further investigate the patterns described in the previous section, we conduct univariate comparisons of pilot, partly treated, and true control firms before the Regulation SHO pilot program. Mean-comparison t-tests between these groups of firms are reported in Panel B of Table 1. First, we compare the characteristics of pilot and original control firms in 2003, which is the fiscal year preceding the identification of the pilot firms. We find that pilot and original control firms have similar firm characteristics, including payout measures, indicating that the initial selection of pilot firms is truly random. However, for robustness, we account for the busted randomization and compare pilot, partly treated, and true control firms. The results indicate significant differences in firm characteristics between these groups of firms, which is consistent with Litvak et al. (2016) findings pointing out that partly treated firms are larger and thus significantly different from true controls. Lastly, we compare true control and pilot firms. Following Litvak et al. (2016), we use firms whose natural logarithm of market capitalization is less than 7.8 to compare firms of similar sizes. These firms are more similar across various firm characteristics, although there are significant differences in *P(TotalPayout)* and income. Overall, these tests show that the sample of pilot firms is representative.

4.4. The impact of regulation SHO on short-selling pressure

The central assertion of this study is that Regulation SHO increases the short-selling pressure of pilot firms when compared with control firms. Authors such as Alexander and Peterson (2008) and Diether et al. (2009) show that Regulation SHO increased short interest. To verify their results, we obtain data on short sales from the Financial Industry Regulatory Authority (FINRA) website for 2005–2007.[3] We then

[3] The data on short sales can be requested at http://www.finra.org/industry/trf/trf-regulation-sho-pilot-program.

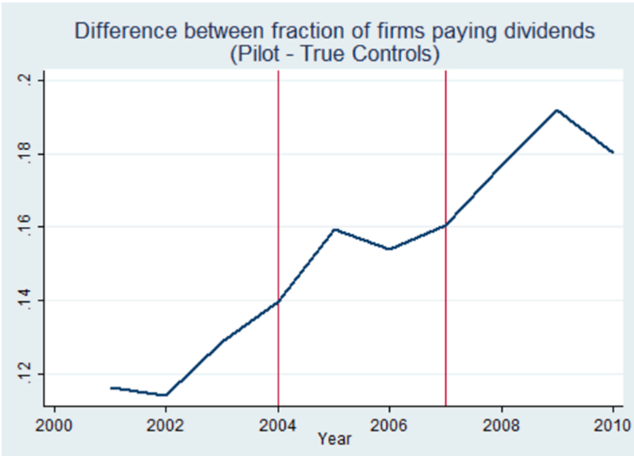

Fig. 1. : Propensity to pay dividends by year. This figure plots the trend in propensity to pay dividends by year for pilot and true control firms.

compare the impact of Regulation SHO on the short sales of pilot, partly treated, and true control firms. Panel C of Table 1 reports NASDAQ listed stocks, and Panel D of Table 1 reports NYSE listed stocks. They show that pilot firms experience a significant increase in short volume and the number of short sales relative to true control firms. We also examine the short volume scaled by shares outstanding or total volume and find that pilot firms have significantly higher short volume than both true controls and partly treated firms. We find that these differences between pilot and control firms are more pronounced for NYSE-listed stocks. Overall, these results are consistent with the extant literature and indicate that pilot firms are subjected to greater short-selling pressure during Regulation SHO.

Next, we examine the short-selling activity of pilot and true control firms around the announcement of dividend increases and share repurchases. Fig. 5 shows that short volume scaled by shares outstanding increases for pilot firms before the dividend increase announcement and decreases after the dividend increase announcement. Fig. 6 examines short sales around repurchase announcements. Similar to dividend increase announcements, we find that short volume scaled by shares outstanding increases for both pilot and true controls before the repurchase announcement and decreases subsequently. This increase is greater for true controls firms. These results are consistent with the argument that dividend increases and share repurchases can be used to deter short sellers. Overall, our results are consistent with the argument that short-selling pressure increases for pilot firms during Regulation SHO and that increasing dividends mitigates short sales.

5. Empirical results

5.1. The impact of the regulation SHO pilot program on dividend changes

In this sub-section, we investigate Regulation SHO's impact on dividend policy changes. First, we examine the propensity to pay dividends. Then, to gain further insights into what drives dividend changes, we

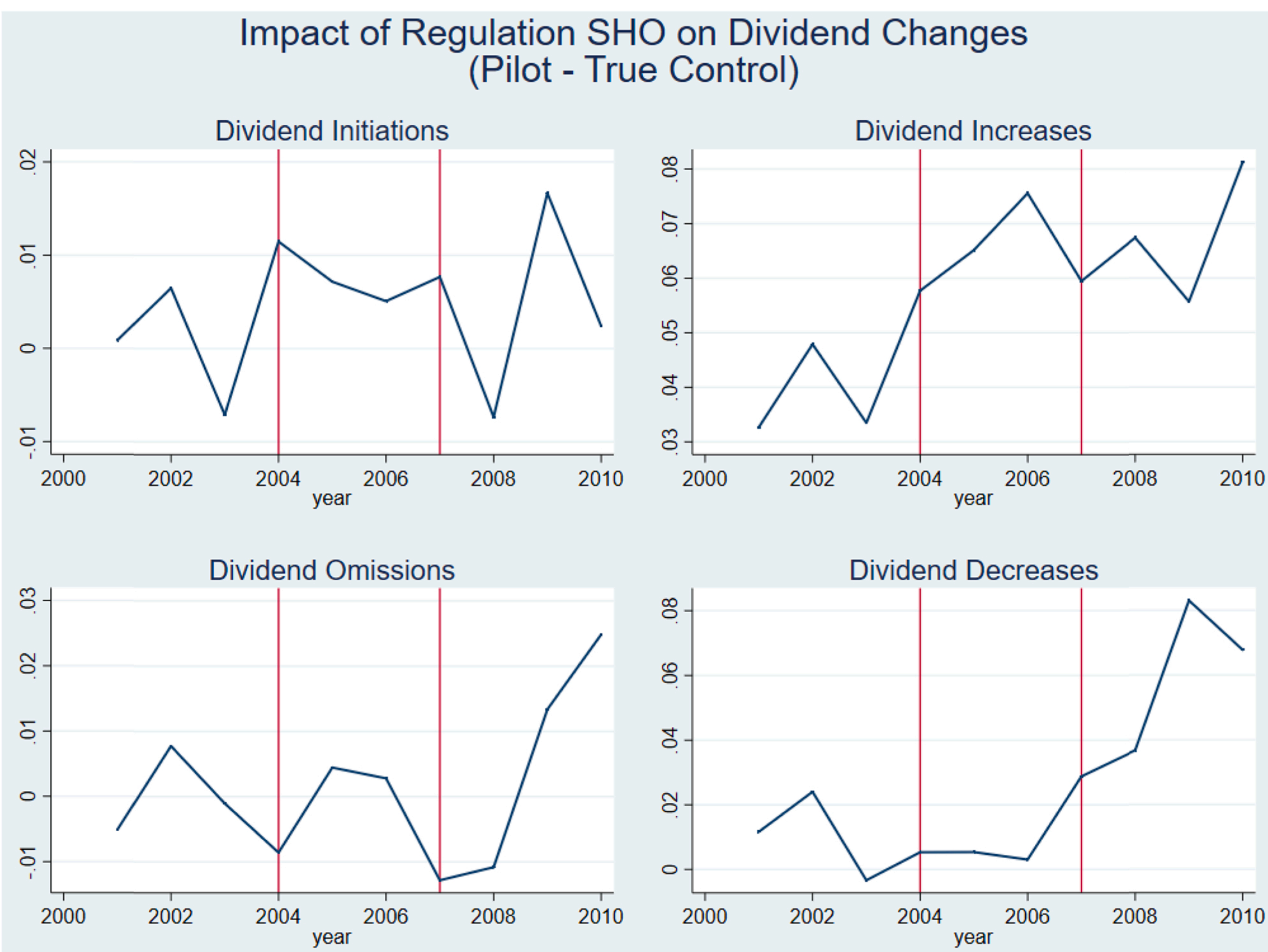

Fig. 2. : Impact of Regulation SHO on dividend changes. This figure plots the trend in propensity to initiate, increase, omit or decrease dividends by year for pilot and true control firms.

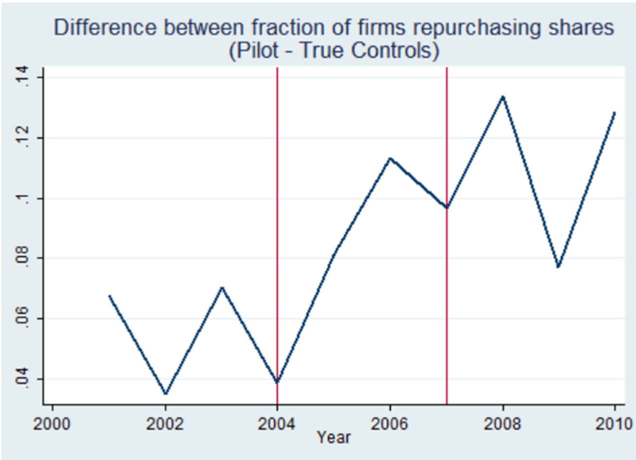

Fig. 3. : Propensity to repurchase shares by year. This figure plots the trend in propensity to repurchase shares by year for pilot and true control firms.

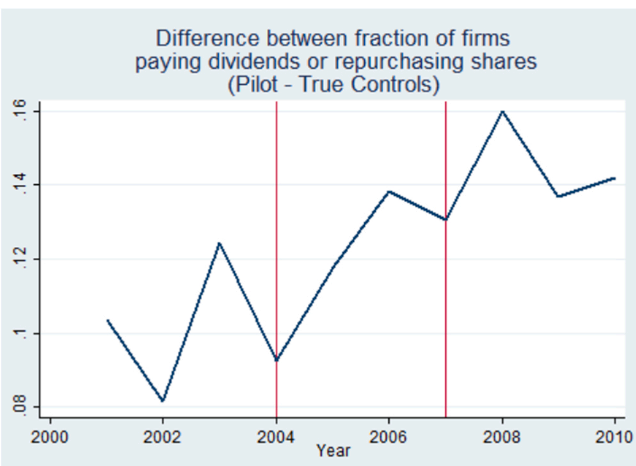

Fig. 4. : Propensity to pay dividends or repurchase shares by year. This figure plots the trend in propensity to pay dividends or repurchase shares by year for pilot and true control firms.

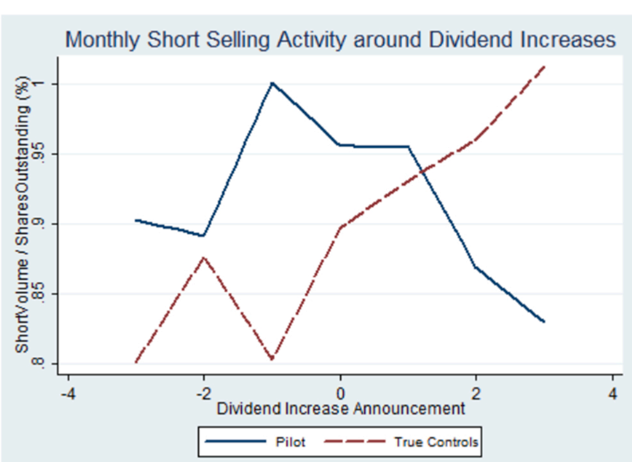

Fig. 5. : Short selling activity around dividend increase announcements. This figure plots the monthly short volume scaled by shares outstanding around dividend announcements for pilot and true control firms.

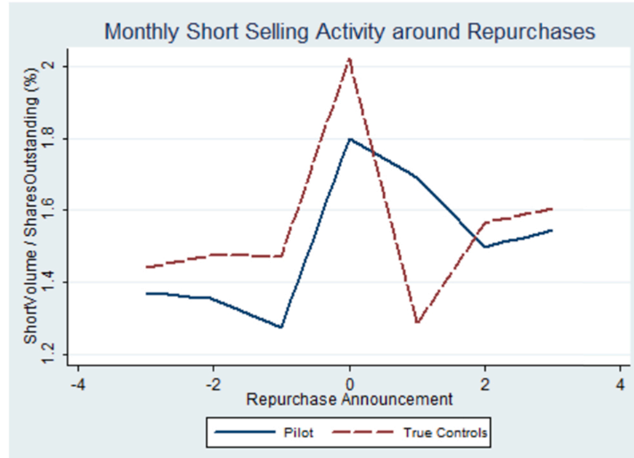

Fig. 6. : Short selling activity around repurchase announcements. This figure plots the monthly short volume scaled by shares outstanding around repurchase announcements for pilot and true control firms.

examine the propensity to initiate, increase, omit, and cut dividends. Specifically, we estimate Eq. (1) using *P(Dividend)*, *P(Initiate)*, *P(Increase)*, *P(Omit)*, or *P(Decrease)* as the dependent variable and report these results in Panel A of Table 2. The variable of interest is the *Pilot*During* dummy variable. The coefficient on this variable compares pilot and non-pilot firms' payout policies before and during the pilot program.

Litvak et al. (2016) show that the selection of pilot firms is not completely random. Chen et al. (2018) find that short selling impacts the dollar amount of cash dividends only for small firms. The effect of the busted randomization is one possible explanation for why the impact of Regulation SHO on dividends is more pronounced for small firms.[4] Thus, we divide the firms into pilot, partly treated, and true control firms using the procedure by Litvak et al. (2016) and examine three specifications. We also control for year fixed effects and industry fixed effects using Fama-French 48 Industry Classification in all specifications.

First, we examine the impact of Regulation SHO on the pilot firms when compared with the original control firms. Table 2, Panel A shows that pilot firms are more likely to increase dividends and less likely to decrease or omit dividends than the original controls. However, these results may be biased by the inclusion of partly treated firms in the control group. Panel B compares partly treated firms with the true controls and shows that the former are more likely to pay, initiate, and increase dividends than the latter. Furthermore, they are subjected to short-selling pressure and are larger, which could explain why their dividend policy is more significantly impacted than that of the true controls. Finally, Panel C uses pilot and true control firms whose natural logarithm of market capitalization is less than 7.8. True control firms do not experience any short-selling pressure and comparing these firms with pilot firms provides a cleaner test of the impact of an increase in short-selling pressure on dividends for firms of similar size. The results show that pilot firms are 3.6% more likely to pay dividends than true control firms. Additionally, the coefficient on the *Pilot*During* variable is statistically significant when the dependent variable is *P(Increase)* or *P (Omit)*. We find that pilot firms are 3.3% more likely to increase dividends and 0.6% less likely to omit dividends during the *During-Pilot-Program* period.

The results of the control variables in each specification are

[4] We re-estimate the model by Chen et al. (2018) after accounting for the busted randomization in Appendix B and find that the impact of an increase in the prospect of short selling on cash dividends is more pronounced for pilot firms compared to true control firms of similar size.

Table 2
Impact of Regulation SHO pilot program on changes in payout policy. This table reports the estimation of the differences-in-differences model that examines the impact of Regulation SHO on changes in payout policy after controlling for the busted randomization (Litvak, Black and Yoo, 2016). Panel A, B and C examine the impact on dividend changes. Panel D examines the impact on repurchases and total payout. *P(Dividends)* is one if a firm pays dividends and zero otherwise. *P(Initiate)* is one if a non-dividend paying firm initiates dividends and zero otherwise. *P(Increase)* is one if a dividend paying firm increases dividends and zero otherwise. *P(Omit)* is one if a dividend paying firm does not pay dividends and zero otherwise. *P(Decrease)* is one if a dividend paying firm decreases dividends and zero otherwise. *P(Repurchases)* is one if a firm repurchases shares and zero otherwise. *P(TotalPayout)* is one if a firm pays dividend or repurchases shares and zero otherwise. *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the fiscal year end falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the fiscal year end falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Industry (Fama-French 48 industry classification) and year fixed effects are included as specified but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2001–2010 (2004 omitted). * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Panel A: Original control firms vs. Pilot firms

Dependent Variable	*P (Dividend)*	*P (Initiate)*	*P (Increase)*	*P (Omit)*	*P (Decrease)*
	(1)	(2)	(3)	(4)	(5)
*Pilot*During*	0.010	-0.001	0.018 *	-0.007 * **	-0.014 *
	(0.006)	(0.006)	(0.009)	(0.002)	(0.007)
*Pilot*Post*	0.034 * *	-0.001	0.018	-0.005	0.015
	(0.013)	(0.007)	(0.011)	(0.007)	(0.011)
Pilot	0.023	0.001	0.023	0.005 * **	0.006
	(0.017)	(0.005)	(0.014)	(0.001)	(0.007)
Observations	14,362	14,362	14,362	14,362	14,362
Adj R-squared	0.252	0.007	0.193	0.013	0.061
Controls	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel B: Partly treated firms vs True control firms

Dependent Variable	*P (Dividend)*	*P (Initiate)*	*P (Increase)*	*P (Omit)*	*P (Decrease)*
	(1)	(2)	(3)	(4)	(5)
*Pilot*During*	0.044 * *	0.011 * *	0.053 * *	0.001	-0.006
	(0.016)	(0.005)	(0.017)	(0.005)	(0.015)
*Pilot*Post*	0.039	-0.008	-0.004	0.003	0.049 * *
	(0.023)	(0.008)	(0.019)	(0.010)	(0.018)
Pilot	0.183 * **	0.006 *	0.160 * **	-0.001	0.014
	(0.027)	(0.003)	(0.022)	(0.003)	(0.013)
Observations	9363	9363	9363	9363	9363
Adj R-squared	0.282	0.009	0.220	0.014	0.058
Controls	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel C: Pilot vs True controls (ln (market cap) < 7.8)

Dependent Variable	*P (Dividend)*	*P (Initiate)*	*P (Increase)*	*P (Omit)*	*P (Decrease)*
	(1)	(2)	(3)	(4)	(5)
*Pilot*During*	0.036 * **	0.007	0.033 * *	-0.006 * **	-0.004
	(0.010)	(0.006)	(0.012)	(0.002)	(0.012)
*Pilot*Post*	0.078 * **	0.005	0.039	0.001	0.042 * **
	(0.021)	(0.009)	(0.018)	(0.009)	(0.012)
Pilot	0.015	-0.001	0.016	0.004 * *	0.0022
	(0.019)	(0.005)	(0.015)	(0.001)	(0.008)
Observations	9593	9593	9593	9593	9593
Adj R-squared	0.207	0.010	0.150	0.019	0.073
Controls	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel D: Impact on repurchases and total payout

Dependent variable	P (*Repurchases*)			*P (Total Payout)*		
	(1)	(2)	(3)	(4)	(5)	(6)
	Original Controls vs. Pilot	True Controls vs. Partly Treated	True Controls vs. Pilot (ln(mrktcap) < 7.8)	Original Controls vs. Pilot	True Controls vs. Partly Treated	True Controls vs. Pilot (ln(mrktcap) < 7.8)
*Pilot*During*	-0.018	0.100 * **	-0.009	0.001	0.027	0.013
	(0.016)	(0.025)	(0.023)	(0.010)	(0.024)	(0.019)
*Pilot*Post*	0.042 *	-0.020	0.022	0.039 *	-0.033	0.052
	(0.022)	(0.039)	(0.032)	(0.022)	(0.024)	(0.032)
Pilot	-0.006	0.200 * **	0.018	0.009	0.247 * **	0.027
	(0.016)	(0.022)	(0.018)	(0.016)	(0.022)	(0.019)
Observations	14,362	9363	9593	14,362	9363	9593
Adj R-squared	0.102	0.138	0.077	0.149	0.188	0.138
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

consistent with the literature: larger, lower-growth, and more profitable firms are more likely to pay dividends (Fama and French, 2001; DeAngelo et al., 2004).[5] Overall, these results are consistent with the trends observed in Figs. 1 and 2 and show that when compared with true control firms, an increase in short selling pressure leads to pilot firms increasing dividends after accounting for the busted randomization and using firms of similar size. For robustness, we also examine the impact on repurchases and total payout in Panel D. The results show that an increase in short selling does not significantly impact the propensity to repurchase shares when comparing pilot and true control firms. The impact of short-selling pressure on the propensity of the total payout mirrors the preceding results using repurchases, which represent a larger portion of the total payout. These results are consistent with theories arguing that dividends are a stronger and more credible signal than share repurchases (John and Williams, 1985; Allen et al., 2002; Jagannathan et al., 2000).

When combined, these findings show that the change in dividend behavior during the *During-PilotProgram* period is driven by the propensity to increase dividends, implying that dividend-paying firms use dividend increases to mitigate the impact of the increase in the prospect of short selling. However, for non-dividend paying firms, the increase in the prospect of short selling does not significantly impact the propensity to initiate dividends. Grullon and Michaely (2002) point out that firms prefer to initiate cash payouts using repurchases instead of dividends. As a result, firms that have never initiated a cash payout may be reluctant to use dividends despite the increase in the prospect of short selling. Furthermore, omissions and decreases in dividends payments are viewed negatively by the market (Michaely et al., 1995; Brav et al., 2005). Regulation SHO could have distorted prices, making firms even more reluctant to decrease or omit dividends.

Overall, the results indicate that an increase in the prospect of short selling significantly impacts the propensity to pay dividends and make changes to the current dividend policy during the pilot program. Specifically, pilot firms are more likely to increase dividends and less likely to omit dividends during the pilot program. It should also be noted that the effects of Regulation SHO on firms' payout policy are economically meaningful when we use the small-scale experiment and compare the pilot firms to the true control firms. For brevity, we focus on these two groups of firms in subsequent analyses, as this sample provides the cleanest test.

5.2. The impact on dividend changes after the end of the regulation SHO pilot program

Our previous findings indicate that the coefficient on the *Pilot*Post* dummy, which compares the *Pre-PilotProgram* and *Post-PilotProgram* periods, is positive and statistically significant when the dependent variable is *P(Dividend)* or *P(Decrease)* in the specifications using pilot firms and true controls, revealing that pilot firms continue to pay dividends and are more likely to decrease dividends after the pilot program ends. To further investigate dividend changes after the end of the pilot program, we re-estimate our model using only the *During-PilotProgram* and *Post-PilotProgram* periods and report our results in Table 3. Our variable of interest is the *Pilot*Post* dummy, which compares the payout policy of pilot firms *During-PilotProgram* and *Post-PilotProgram* periods relative to true control firms.

We begin by examining in Column (1) the impact of the propensity to pay dividends. The coefficient on the *Pilot*Post* dummy is positive and statistically significant, indicating that the propensity to pay dividends does not revert to pre-Regulation SHO levels. Previous research shows that other firms' decisions, such as earnings management (Fang et al., 2016; Chen and Wu, 2021) and innovation (He and Tian, 2014), revert to pre-Regulation SHO levels after the pilot program ends. However, we find that the impact on the propensity to pay dividends is persistent. This finding is consistent with studies such as Lintner (1956).

Table 3
Impact on Dividend Changes after end of the Regulation SHO Pilot Program. This table reports the impact after the pilot program for pilot and true control firms whose natural logarithm of market capitalization is less than 7.8. *P(Dividends)* is one if a firm pays dividends and zero otherwise. *P(Initiate)* is one if a non-dividend paying firm initiates dividends and zero otherwise. *P(Increase)* is one if a dividend paying firm increases dividends and zero otherwise. *P(Omit)* is one if a dividend paying firm does not pay dividends and zero otherwise. *P (Decrease)* is one if a dividend paying firm decreases dividends and zero otherwise. *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the fiscal year end falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the fiscal year end falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Industry (Fama-French 48 industry classification) and year fixed effects are included as specified but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2005–2010. * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Dependent Variable	*P (Dividend)* (1)	*P (Initiate)* (2)	*P (Increase)* (3)	*P (Omit)* (4)	*P (Decrease)* (5)
*Pilot*Post*	0.042 * **	-0.003	0.007	0.007	0.046 * *
	(0.010)	(0.007)	(0.018)	(0.009)	(0.017)
Pilot	0.054 *	0.008 * **	0.049 * *	-0.002	0.002
	(0.023)	(0.001)	(0.020)	(0.002)	(0.013)
Observations	5752	5752	5752	5752	5752
Adj R-squared	0.196	0.012	0.163	0.028	0.065
Controls	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Next, we examine the impact on *P(Initiate)*, *P(Increase)*, *P(Omit)*, and *P(Decrease)*. Columns (2), (3), and (4) show that the impact on the propensity to initiate, increase, or omit dividends is not statistically significant, indicating that although the propensity to pay dividends is persistent, if pilot firms have not increased or initiated dividends during the pilot program, they have no incentive to do so following its end. In Column (5), the impact on *P(Decrease)* is positive and statistically significant, suggesting that pilot firms are more likely to decrease dividends during the *Post-PilotProgram* period. Brav et al. (2005), among others, point out that dividend-paying firms are reluctant to cut dividends. However, we show that pilot firms are more likely to start decreasing dividends during the *Post-PilotProgram* period despite the possible negative market reaction, which suggests that some pilot firms may have prematurely increased dividends during the pilot program while decreasing their dividend payments following the end of the pilot program. In summary, we find that pilot firms continue to pay dividends but are more likely to decrease dividends after the pilot program ends.

5.3. The impact of the regulation SHO pilot program on dividend smoothing

So far, our findings indicate that pilot firms make more changes to their payout policy through dividend increases, omissions, and decreases during the sample period. Specifically, pilot firms are more likely to increase and less likely to omit dividends during the *During-PilotProgram* period and more likely to decrease dividends during the *Post-PilotProgram* period. Michaely and Roberts (2012) point out that firms that make more changes to their dividend policies in response to transitory shocks are less likely to smooth dividends. Thus, our results provide indirect evidence that pilot firms are less likely to smooth dividends than true control firms during the pilot program. In this section, we investigate firms' smoothing behavior by measuring adjustment speed

[5] In other specifications, we include firm fixed effects and drop the pilot dummy. The results from these specifications are reported in Appendix C and provide consistent results.

based on Lintner's (1956) and Leary and Michaely's (2011) partial adjustment models.

We estimate Lintner's (1956) model using Eq. (3) and Leary and Michaely's (2011) model using Eq. (4). To avoid unrealistic economic estimates, we require each firm to have non-missing data for our entire sample period and at least two non-zero dividend payments during the sample period.[6] Our variable of interest in both models is adjustment speed, estimated as $\widehat{\beta_1}$. A large speed of adjustment value implies that the firm's dividend policies are undergoing large changes, whereas small values indicate that firms are trying to smooth dividends over time. We report the summary statistics of these parameters in Panel A of Table 4. Our results show that pilot firms have higher adjustment speeds than true control firms, indicating that pilot firms smooth less.

To further investigate adjustment speed, we divide our sample into firms with positive and negative deviations from the target ratio for pilot and true control firms. Panel B of Table 4 reports the distribution of adjustment speed by deviation. A positive (negative) deviation indicates that the target payout ratio is greater (smaller) than the previous year's dividend. Furthermore, adjustment speed is lower when the deviation is positive for both pilot and true control firms, and pilot firms have a higher adjustment speed than true control firms when the deviation is positive. However, the adjustment speed is similar for pilot and true control firms when the deviation from the target payout ratio is negative. Overall, these results indicate that pilot firms smooth less during the pilot program, and these results are driven by firms with a positive deviation from the target payout ratio. For robustness, in Panel C of Table 4, we estimate adjustment speed for firms that repurchase shares and find that repurchase activity does not impact our overall results. Additionally, we use total payout in Panel D of Table 4 and find consistent results.

After the pilot program ended in 2007, short sale price tests were removed for all firms. Then, in 2010, the SEC announced a modified rule that is triggered when a security's price declines by 10% or more from the previous closing price. We examine the time-period 2011–2018 to investigate whether these changes in dividend smoothing continue following the end of the pilot program under the new short-sale restrictions. We estimate the parameters for both Lintner's (1956) and Leary and Michaely's (2011) models and report the summary statistics for these parameters in Table 5. Our results show that adjustment speed increases for both pilot and true control firms. However, pilot firms have lower speeds of adjustment relative to true control firms between 2011 and 2018, indicating that they smooth more than true control firms.

In summary, we find that pilot firms continue to pay dividends but are more likely to decrease them after the pilot program ends. Equally, they have lower speeds of adjustments following the end of the Regulation SHO, when the increase in the prospect of short selling is reduced. Thus, to the extent that short-selling pressure increases sensitivity to transitory shocks, pilot firms are less likely to smooth dividends. When combined, our findings suggest that stock-price dynamics influence firms' smoothing behavior.

6. Signaling and agency channels

Our results suggest that managers are more likely to make changes to their dividend policy and reduce dividend smoothing when there is an increase in the prospect of short selling. That is, despite the case that managers value stable dividends (Brav et al., 2005), they prefer to increase them at the expense of smooth dividends when faced with short-selling threats. These results are consistent with signaling (Miller and Rock, 1985; John and Williams, 1985) and agency-based explanations (Easterbrook, 1984; Jensen, 1986) for payout policy. Leary and Michaely (2011) also point out that information asymmetry and governance can impact firms' smoothing. In this section, we explore signaling and agency-based explanations for why pilot firms are more likely to change their dividend policy and smooth less when the prospect of short selling increases. Specifically, we focus on dividend increases because our findings indicate that pilot firms are more likely to increase dividends during the pilot program.

6.1. Signaling explanation

The signaling argument contends that firms use payouts as a signaling device to relay information on firm value (Bhattacharya, 1979; Miller and Rock, 1985; John and Williams, 1985). Allen et al. (2002) show that dividends are a signal of firm quality, and lower quality firms do not have the incentive to imitate higher quality firms because of the high cost that doing so would impose. Similarly, Spence (1973) states in his seminal paper that the incentive for firms to signal that they are financially stable is greater when uncertainty is high. In this section, we use cross-sectional analyses to investigate the impact of information asymmetry (Section 6.1.1) and firm performance (Section 6.1.2) on the relationship between payout policy and short selling.

6.1.1. Information asymmetry

Short-selling activity changes the price dynamics, exacerbating information asymmetry (Henry and Koski, 2010), whereas dividends can be used as a signal to mitigate it (Miller and Rock, 1985). Consequently, firms with a weaker information environment are more vulnerable to the increase in the prospect of short selling and have a greater incentive to signal using dividends and smooth less.

We use three measures of information asymmetry to capture various aspects of uncertainty. The first measure is accruals quality, which captures the quality of financial reports (Lee and Masulis, 2009). Hirshleifer et al. (2011) show that overvalued firms characterized by high accruals are more susceptible to short arbitrage. Following Hirshleifer et al. (2011), we define *accruals* as the difference between earnings before extraordinary items and cash flows from operations scaled by total assets. Second, we measure uncertainty based on analyst coverage. The extant literature posits that firms with lower analyst following tend to produce more opaque information. We define *Number of Analysts* as the median number of analysts following the firm during fiscal year *t*. Third, we measure information asymmetry based on stock-price informativeness using the probability of informed trade (PIN) measure developed by Easley et al. (2002). Stocks with lower PIN tend to have less informative stock prices. Based on these information asymmetry measures, we conduct our analysis using the top and bottom terciles of firm-year observations and report the results in Table 6.

We examine the distributions of the speed of adjustment in Panel A and the propensity to increase dividends in Panel B using sub-samples based on the information asymmetry measures. Our findings show that pilot firms with higher accruals, fewer analysts, and less informative prices have higher speeds of adjustment, indicating that these pilot firms are less likely to smooth. Additionally, the impact of an increase in the prospect of short selling on the propensity to increase dividends is stronger for pilot firms featured by higher uncertainty. We conduct another similar cross-sectional analysis using either the propensity to repurchase shares or the propensity of total payout as the dependent variable. These results, reported in Panel C and D of Table 6, are weaker than those reflecting firms' propensity to increase dividends, consistent with the view that firms with relatively higher information asymmetry use payouts, in particular dividends, as a signaling device.

6.1.2. Firm performance

Dividends are a costly signal (John and Williams, 1985; Bhattacharya and Jacobsen, 2015). Consequently, firms with stronger financials are better equipped to use dividends as a signal. We measure firm performance through market-to-book, ROA, and Tobin's Q and divide

[6] In unreported robustness tests, we use quarterly data, which provide us with more observations per firm and greater statistical power. We find consistent results.

Table 4
Impact of Regulation SHO on Dividend Smoothing. This table reports the distributions of parameters from Lintner (1956) and Leary and Michaely (2011) smoothing models for pilot and true control firms. Variables are defined in Appendix A.

Panel A: Smoothing model of dividends during the period 2001–2003 (inclusive) and 2005–2010 (inclusive)

	Lintner (1956)				Leary and Michealy (2011)			
	Pilot Firms							
Variables	Mean (1)	SD (2)	Min (3)	Max (4)	Mean (5)	SD (6)	Min (7)	Max (8)
Speed of adjustment	0.377	0.652	-2.150	3.031	0.223	0.414	-1.307	1.172
Target payout ratio	0.088	0.964	-3.122	5.164	0.181	0.187	0.000	1.020
Constant	0.149	0.429	-0.550	2.339	0.070	0.121	-0.093	0.759
Number of firms	144	144	144	144	144	144	144	144
	True Control Firms							
	Mean	SD	Min	Max	Mean	SD	Min	Max
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Speed of adjustment	0.288	0.697	-2.150	3.031	0.203	0.406	-1.307	1.234
Target payout ratio	0.165	0.886	-3.122	5.164	0.202	0.216	0.000	1.020
Constant	0.077	0.446	-1.246	2.663	0.076	0.159	-0.093	1.168
Number of firms	163	163	163	163	163	163	163	163

Panel B: Speed of Adjustment by deviation from target payout ratio using Leary and Michealy (2011) model

	Pilot Firms				True Control Firms			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Speed of adjustment (Deviation > 0)	0.149	0.228	-0.079	0.911	0.073	0.405	-1.307	1.234
Speed of adjustment (Deviation <= 0)	0.248	0.457	-1.307	1.172	0.245	0.398	-1.307	1.234
Number of firms	144	144	144	144	163	163	163	163

Panel C: Smoothing model of dividends for firms that repurchase shares during the period 2001–2003 (inclusive) and 2005–2010 (inclusive)

	Lintner (1956)				Leary and Michealy (2011)			
	Pilot Firms							
Variables	Mean (1)	SD (2)	Min (3)	Max (4)	Mean (5)	SD (6)	Min (7)	Max (8)
Speed of adjustment	0.382	0.668	-2.178	3.197	0.243	0.445	-1.681	1.172
Target payout ratio	0.0961	1.067	-3.122	5.852	0.174	0.188	0.000	1.060
Constant	0.136	0.422	-0.550	2.339	0.0679	0.116	-0.102	0.759
Number of firms	137	137	137	137	137	137	137	137
	True Control Firms							
	Mean	SD	Min	Max	Mean	SD	Min	Max
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Speed of adjustment	0.303	0.732	-2.178	3.197	0.217	0.426	-1.681	1.477
Target payout ratio	0.195	0.967	-3.122	5.852	0.200	0.213	0.000	1.060
Constant	0.052	0.555	-1.908	2.955	0.0774	0.168	-0.102	1.296
Number of firms	143	143	143	143	143	143	143	143

Panel D: Smoothing model of total payout during the period 2001–2003 (inclusive) and 2005–2010 (inclusive)

	Lintner (1956)				Leary and Michealy (2011)			
	Pilot Firms							
Variables	Mean (1)	SD (2)	Min (3)	Max (4)	Mean (5)	SD (6)	Min (7)	Max (8)
Speed of adjustment	0.838	0.481	-0.643	2.574	0.738	0.401	-0.440	1.573
Target payout ratio	0.339	1.108	-5.250	6.133	0.261	0.362	-0.046	1.594
Constant	0.246	0.903	-3.508	5.282	0.257	0.383	-0.213	2.434
Number of firms	273	273	273	273	273	273	273	273
	True Control Firms							
	Mean	SD	Min	Max	Mean	SD	Min	Max
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Speed of adjustment	0.821	0.481	-0.643	2.574	0.722	0.415	-0.440	1.573
Target payout ratio	0.209	1.078	-5.250	6.133	0.220	0.322	-0.046	1.594
Constant	0.253	1.029	-5.007	5.282	0.277	0.412	-0.177	2.434
Number of firms	363	363	363	363	363	363	363	363

firm-year observations of these financial measures into terciles. Then, we estimate our baseline regression for the top and bottom terciles separately and report the results in Table 7. Panel A shows that pilot firms with higher ROA, market-to-book, and Tobin's Q have higher speeds of adjustments and thus smooth less. Panel B shows that the effect of an increase in the likelihood of short selling on the propensity to increase dividends is more pronounced for these pilot firms. In Panel C and D of Table 7, we use the probability of repurchasing shares or total payout and find less pronounced results, which is consistent with the view that dividends are a stronger signal.

6.2. *Agency-based explanation*

In this sub-section, we examine the extent to which agency-based models of firms' payout policies explain the increase in payout following the increase in short-selling pressure as reflected in Regulation

Table 5
Impact of Regulation SHO on Dividend Smoothing after the Pilot Program. This table reports the distributions of parameters from Lintner (1956) and Leary and Michaely (2011) smoothing models for pilot and true control during the period 2011–2018. Variables are defined in Appendix A.

	Lintner (1956)				Leary and Michealy (2011)			
	Pilot Firms							
Variables	Mean (1)	SD (2)	Min (3)	Max (4)	Mean (5)	SD (6)	Min (7)	Max (8)
Speed of adjustment	0.378	0.726	-2.838	2.360	0.312	0.423	-0.470	1.371
Target payout ratio	0.339	1.108	-5.250	6.133	0.261	0.362	-0.046	1.594
Constant	0.246	0.903	-3.508	5.282	0.257	0.383	-0.213	2.434
Number of firms	113	113	113	113	93	93	93	93
	True Control Firms							
	Mean	SD	Min	Max	Mean	SD	Min	Max
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Speed of adjustment	0.473	0.599	-1.600	2.360	0.338	0.409	-0.238	1.333
Target payout ratio	0.209	1.078	-5.250	6.133	0.220	0.322	-0.046	1.594
Constant	0.253	1.029	-5.007	5.282	0.277	0.412	-0.177	2.434
Number of firms	87	87	87	87	97	97	97	97

SHO. Jensen and Meckling (1976), Easterbrook (1984), and others contend that agency conflicts between managers and shareholders can impact the decision to pay, as payouts reduce cash holdings, thereby limiting managerial ability to indulge in wasteful spending. La Porta, López-de-Silanes, Shleifer, and Vishny (2000) contend that dividends can act as either a substitute or a complementary governance mechanism. The complementary view argues that strong governance will pressure firms to pay dividends. Alternatively, dividends are a substitute governance mechanism if firms with poor governance are more likely to pay dividends.

We use cross-sectional analysis to investigate the influence of governance on the relationship between the increase in the prospect of short selling and payout policy. To measure governance, we use the number of institutional investors (Section 6.2.1), product market competition (Section 6.2.2), and CEO incentives (Section 6.2.3).

6.2.1. *Number of institutional investors*

Institutional investors are more incentivized to undertake costly monitoring of managers (Shleifer and Vishny, 1986). Therefore, firms with fewer institutional investors experience less monitoring, and managers have a greater incentive to shirk, which makes these firms particularly vulnerable to the disciplining of market pressure from short-selling activity. Subsequently, the effect of an increase in the prospect of short selling should be greater for firms with low institutional monitoring.

To capture institutional investor monitoring, we use the number of institutional block-holders and divide our sample into terciles based on firm-year observations of this variable. We use the top and bottom terciles to conduct cross-sectional analyses and report the results in Table 8. Panel A shows that pilot firms with fewer institutional block-holders have higher speeds of adjustments, indicating that these firms smooth less. The findings in Panel B show that the impact of an increase in the likelihood of short-selling activity on the propensity to increase dividends is stronger for firms with fewer institutional block-holders. We also investigate the propensity to repurchase shares and the propensity of total payout and find less pronounced results.

6.2.2. *Product market competition*

In non-competitive markets, managers tend to avoid difficult decisions in favor of routine activities (Hicks, 1935). Conversely, product market competition encourages managers to make decisions that will increase long-term firm productivity. Therefore, to the extent that short-selling activity increases market monitoring of managers, the impact of an increase in the likelihood of short selling on dividends should be more pronounced for firms in more competitive markets.

To measure competition, we classify firms into industries using the three-digit SIC industry classification codes or the text-based network classification (TNIC) by Hoberg and Phillips (2016). Then we compute the Herfindahl-Hirschman index (HHI) each year for the industry in which the firm operates (Tirole, 1988). A low HHI indicates that a firm belongs to a competitive industry. We divide our sample into high- and low-competition-based terciles of each HHI measure. Next, we conduct our analysis and report the results in Table 8. The findings in Panel A indicate that pilot firms in the lower terciles have higher speeds of adjustment, suggesting that pilot firms in more competitive industries are less likely to smooth dividends. Panel B shows that the impact of an increase in the likelihood of short-selling activity on the propensity to increase dividends is stronger for firms in more competitive industries. The results are similar but less pronounced using the propensity to repurchase shares or total payout.

6.2.3. *CEO incentives and overconfidence*

Holmstrom (1993) demonstrate that stock prices reflect information about performance that can be used to develop managerial incentives. In addition, De Angelis et al. (2017) show that short selling can increase the convexity of compensation payoffs through its impact on the stock-price formation process. These arguments suggest that managers with weak incentives are vulnerable to short-selling pressure. Moreover, short selling increases career concerns for managers and decreases the level of overconfidence. Therefore, the impact of an increase in the prospect of short selling on dividends should be more pronounced for managers with poorly aligned incentives and low degrees of overconfidence.

A CEO's compensation incentives are more aligned if they are highly correlated with stock performance. We use two measures to capture CEO incentives. First, we use the percentage of stock options as a proportion of total compensation. A larger stock options percentage should increase managerial risk-taking (Guay, 1999). Second, we measure pay-performance sensitivity. Managers with low pay-performance sensitivity are more likely to pursue private benefits (Jensen and Murphy, 1990). Thus, the incentives of CEOs with a greater percentage of stock options or lower pay-performance sensitivity are more poorly aligned with firm performance. We then divide the CEO incentives measures into terciles of firm-year observations and conduct cross-sectional analysis using the top and bottom terciles.

To measure overconfidence, we use two proxies defined by Schrand and Zechman (2012). The first proxy, *OptionDelay*, is the natural logarithm of the value of the CEO's in-the-money unexercised but exercisable options. Malmendier and Tate (2005, 2008) claim that a CEO's delay in exercising options can estimate their degree of overconfidence. The second proxy, *OC_Firm5*, is a score based on five investing and financing measures related to CEO overconfidence. Firms with an *OptionDelay* value greater than the industry median and an *OC_Firm5* score greater than three are regarded as having a higher degree of CEO overconfidence. We use these cutoffs of our CEO overconfidence

Table 6

Signaling models - Information asymmetry. This table reports the results of the differences-in-differences model using cross-sectional analysis to examine the impact of information asymmetry on the relationship between Regulation SHO and payout policy. Subsamples (top and bottom terciles) based on firm-year observations of accruals, number of analysts and Probability of Informed Trading (PIN) are examined. Panel A reports the mean and standard deviation of the speed of adjustment. In Panel B, *P(Increase)* is one if a dividend paying firm increases dividends and zero otherwise. In Panel C, *P(Repurchases)* is one if a firm repurchases shares and zero otherwise. In Panel D, *P(TotalPayout)* is one if a firm pays dividend or repurchases shares and zero otherwise. *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the year falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the year falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Industry (Fama-French 48 industry classification) and year fixed effects are included in all specifications but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2001–2010 (2004 omitted). * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Panel A: Speed of adjustment (SOA) for pilot firms by information asymmetry measures

	Accruals		Number of Analysts		PIN	
	Low	High	Low	High	Low	High
Speed of Adjustment	(1)	(2)	(3)	(4)	(5)	(6)
Mean	0.217	0.235	0.177	0.104	0.129	0.236
SD	0.446	0.463	0.418	0.300	0.398	0.408
Number of firms	56	51	60	71	29	112

Panel B: Impact on the propensity to increase dividends by information asymmetry measures

Dependent variable *P (Increase)*

	Accruals		Number of Analysts		PIN	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	0.021	0.075 * *	0.055 * **	-0.002	-0.001	0.051 * *
	(0.017)	(0.029)	(0.016)	(0.043)	(0.031)	(0.021)
*Pilot*Post*	0.036	0.041	0.038	0.039	0.006	0.042 * *
	(0.027)	(0.035)	(0.025)	(0.042)	(0.040)	(0.019)
Pilot	0.012	0.024	-0.006	0.083 *	0.051 *	-0.011
	(0.013)	(0.024)	(0.018)	(0.039)	(0.023)	(0.019)
Observations	3386	2952	4256	1296	1652	4136
Adj R-squared	0.090	0.180	0.183	0.159	0.146	0.168
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Panel C: Impact on the propensity to repurchase shares by information asymmetry measures

Dependent variable *P (Repurchases)*

	Accruals		Number of Analysts		PIN	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	0.023	-0.027	-0.038	-0.005	-0.139 *	-0.025
	(0.042)	(0.037)	(0.030)	(0.060)	(0.072)	(0.046)
*Pilot*Post*	0.008	0.031	0.043	-0.034	-0.029	0.027
	(0.048)	(0.047)	(0.043)	(0.080)	(0.070)	(0.048)
Pilot	-0.012	0.019	0.053 * *	0.049	0.101	0.037
	(0.035)	(0.038)	(0.023)	(0.061)	(0.061)	(0.022)
Observations	3386	3242	4256	1296	1652	4136
Adj R-squared	0.079	0.076	0.078	0.132	0.116	0.066
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Panel D: Impact on the propensity to pay dividends or repurchase shares by information asymmetry measures

Dependent variable *P (TotalPayout)*

	Accruals		Number of Analysts		PIN	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	0.046	-0.036	0.005	-0.012	-0.056	-0.031
	(0.035)	(0.034)	(0.027)	(0.062)	(0.054)	(0.032)
*Pilot*Post*	0.052	0.054	0.041	0.026	0.062	0.034
	(0.048)	(0.048)	(0.045)	(0.077)	(0.067)	(0.038)
Pilot	-0.011	0.036	0.049 *	0.063	0.107 *	0.026
	(0.036)	(0.028)	(0.025)	(0.066)	(0.053)	(0.023)
Observations	3386	3242	4256	1296	1652	4136
Adj R-squared	0.113	0.157	0.160	0.152	0.175	0.146
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Table 7
Signaling models - Firm performance. This table reports the results of the differences-in-differences model using cross-sectional tests to examine the impact of firm performance on the relationship between Regulation SHO and payout policy. Subsamples (top and bottom terciles) based on firm-year observations of market-to-book, ROA and Tobin's Q are examined. Panel A reports the mean and standard deviation of the speed of adjustment. In Panel B, *P(Increase)* is one if a dividend paying firm increases dividends and zero otherwise. In Panel C, *P(Repurchases)* is one if a firm repurchases shares and zero otherwise. In Panel D, *P(TotalPayout)* is one if a firm pays dividend or repurchases shares and zero otherwise. *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the year falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the year falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Industry (Fama-French 48 industry classification) and year fixed effects are included in all specifications but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2001–2010 (2004 omitted). * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Panel A: Speed of adjustment (SOA) for pilot firms by firm performance measures

	MB		ROA		Tobin's Q	
	Low	High	Low	High	Low	High
Speed of Adjustment	(1)	(2)	(5)	(6)	(7)	(8)
Mean	0.176	0.236	0.259	0.261	0.180	0.321
SD	0.411	0.376	0.498	0.411	0.392	0.464
Number of firms	26	67	31	54	73	31

Panel B: Impact on the propensity to increase dividends by firm performance measures

Dependent variable *P (Increase)*

	MB		ROA		Tobin's Q	
	Low (1)	High (2)	Low (5)	High (6)	Low (7)	High (8)
*Pilot*During*	0.039	0.060 * *	0.025	0.045 *	0.059	0.043 *
	(0.036)	(0.026)	(0.020)	(0.022)	(0.042)	(0.020)
*Pilot*Post*	0.033	0.051	0.009	0.089 *	0.015	0.082 * *
	(0.032)	(0.043)	(0.019)	(0.049)	(0.035)	(0.035)
Pilot	0.001	0.039	-0.000	0.046	0.010	0.025
	(0.031)	(0.023)	(0.016)	(0.027)	(0.031)	(0.018)
Observations	3788	2633	3792	2718	3597	2959
Adj R-squared	0.108	0.243	0.107	0.161	0.112	0.237
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Panel C: Impact on the propensity to repurchase shares by firm performance measures

Dependent variable *P (Repurchases)*

	MB		ROA		Tobin's Q	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	-0.019	-0.015	0.005	0.019	-0.065	-0.014
	(0.037)	(0.034)	(0.030)	(0.044)	(0.038)	(0.035)
*Pilot*Post*	-0.025	0.029	-0.002	0.100 * *	-0.025	0.095 * *
	(0.038)	(0.046)	(0.035)	(0.043)	(0.046)	(0.042)
Pilot	0.037	0.043 *	0.021	-0.035	0.040	0.020
	(0.022)	(0.023)	(0.021)	(0.032)	(0.023)	(0.024)
Observations	3788	2633	3845	2622	3597	2959
Adj R-squared	0.084	0.137	0.079	0.073	0.063	0.192
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Panel D: Impact on the propensity to pay dividends or repurchase shares by firm performance measures

Dependent variable *P (TotalPayout)*

	MB		ROA		Tobin's Q	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	-0.005	-0.013	0.039	0.052	-0.014	-0.007
	(0.029)	(0.036)	(0.031)	(0.049)	(0.037)	(0.032)
*Pilot*Post*	0.025	0.044	0.027	0.145 * *	0.008	0.109 * *
	(0.039)	(0.043)	(0.040)	(0.049)	(0.046)	(0.039)
Pilot	0.032	0.059 *	0.017	-0.019	0.045	0.029
	(0.024)	(0.028)	(0.026)	(0.039)	(0.025)	(0.028)
Observations	3788	2633	3845	2622	3597	2959
Adj R-squared	0.129	0.204	0.130	0.109	0.096	0.254
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Table 8

Agency models: Product market competition and institutional investors. This table reports the results of the differences-in-differences model using cross-sectional tests to examine the impact of governance on the relationship between Regulation SHO and payout policy. Subsamples (top and bottom terciles) based on firm-year observations of the number of institutional investors and the Herfindahl-Hirschman (HH) Index are examined. Panel A reports the mean and standard deviation of the speed of adjustment. In Panel B, *P(Increase)* is one if a dividend paying firm increases dividends and zero otherwise. In Panel C, *P(Repurchases)* is one if a firm repurchases shares and zero otherwise. In Panel D, *P(TotalPayout)* is one if a firm pays dividend or repurchases shares and zero otherwise. *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the year falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the year falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Industry (Fama-French 48 industry classification) and year fixed effects are included in all specifications but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2001–2010 (2004 omitted). * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Panel A: Speed of adjustment (SOA) for pilot firms by governance measures

	Number of Block-holders		HHI		TNIC HHI	
	Low	High	Low	High	Low	High
Speed of Adjustment	(1)	(2)	(3)	(4)	(5)	(6)
Mean	0.234	0.176	0.237	0.153	0.257	0.191
SD	0.411	0.476	0.346	0.474	0.338	0.412
Number of firms	59	43	48	61	83	33

Panel B: Impact on the propensity to increase dividends by governance measures

Dependent variable *P (Increase)*

	Number of Block-holders		HHI		TNIC HHI	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	0.088 *	0.044	0.089 * **	-0.046 *	0.061 * **	0.014
	(0.047)	(0.034)	(0.020)	(0.022)	(0.018)	(0.046)
*Pilot*Post*	0.099 * *	0.031	0.122 * **	-0.027	0.065 * **	-0.020
	(0.043)	(0.022)	(0.032)	(0.034)	(0.020)	(0.038)
Pilot	0.022	0.001	-0.011	0.057 *	-0.005	0.053
	(0.020)	(0.022)	(0.021)	(0.0281)	(0.015)	(0.034)
Observations	2345	4309	3107	3210	3122	3175
Adj R-squared	0.256	0.158	0.170	0.166	0.138	0.126
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Panel C: Impact on the propensity to repurchase shares by governance measures

Dependent variable *P (Repurchases)*

	Number of Block-holders		HHI		TNIC HHI	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	0.067	-0.094 *	-0.020	-0.044	-0.027	-0.039
	(0.059)	(0.044)	(0.050)	(0.038)	(0.030)	(0.039)
*Pilot*Post*	0.093 *	-0.094	-0.043	0.028	-0.001	0.053
	(0.050)	(0.059)	(0.061)	(0.050)	(0.044)	(0.037)
Pilot	-0.002	0.074 *	0.020	0.031	0.051 * *	-0.0024
	(0.026)	(0.036)	(0.027)	(0.033)	(0.022)	(0.029)
Observations	3399	2671	3107	3210	3122	3175
Adj R-squared	0.080	0.082	0.097	0.069	0.097	0.077
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Panel D: Impact on the propensity to pay dividends or repurchase shares by governance measures

Dependent variable *P (TotalPayout)*

	Number of Block-holders		HHI		TNIC HHI	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
*Pilot*During*	0.039	-0.025	0.039	-0.040	-0.008	0.035
	(0.039)	(0.039)	(0.040)	(0.032)	(0.032)	(0.020)
*Pilot*Post*	0.092 *	-0.036	0.033	0.021	0.031	0.086 *
	(0.043)	(0.058)	(0.056)	(0.050)	(0.041)	(0.040)
Pilot	0.016	0.083 *	0.002	0.067 *	0.045 *	-0.004
	(0.027)	(0.039)	(0.031)	(0.037)	(0.023)	(0.029)
Observations	3399	2671	3107	3210	3122	3175
Adj R-squared	0.172	0.117	0.136	0.121	0.131	0.103

(*continued on next page*)

Table 8 (*continued*)

Panel D: Impact on the propensity to pay dividends or repurchase shares by governance measures

Dependent variable *P (TotalPayout)*

	Number of Block-holders		HHI		TNIC HHI	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
Controls	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Table 9

Agency models - CEO incentives and behavior. This table reports the results of the differences-in-differences model using cross-sectional tests to examine the impact of CEO incentives on the relationship between Regulation SHO and payout policy. Subsamples (top and bottom terciles) based on firm-year observations of CEO incentives: Percentage of Options and Pay Performance Sensitivity (PPS), and CEO overconfidence measures: OptionDelay (value of the CEO's in-the-money unexercised but exercisable options) and *OC_Firm5* (score based on five investing and financing measures) are examined. Panel A reports the mean and standard deviation of the speed of adjustment. In Panel B, *P(Increase)* is one if a dividend paying firm increases dividends and zero otherwise. In Panel C, *P(Repurchases)* is one if a firm repurchases shares and zero otherwise. In Panel D, *P(TotalPayout)* is one if a firm pays dividend or repurchases shares and zero otherwise. *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the year falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the year falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Industry (Fama-French 48 industry classification) and year fixed effects are included in all specifications but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2001–2010 (2004 omitted). * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Panel A: Speed of adjustment (SOA) for pilot firms by CEO incentives

	% Options		PPS		OptionDelay		OC_Firm5	
	Low	High	Low	High	0	1	0	1
Speed of Adjustment	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean SOA	0.222	0.191	0.267	0.230	0.243	0.106	0.236	0.159
SD	0.382	0.395	0.341	0.328	0.415	0.397	0.416	0.406
Number of firms	29	32	30	22	123	21	23	121

Panel B: Impact on the propensity to increase dividends by CEO incentives

Dependent variable *P (Increase)*

	% Options		PPS		OptionDelay		OC_Firm5	
	Low (1)	High (2)	Low (3)	High (4)	0 (5)	1 (6)	0 (7)	1 (8)
*Pilot*During*	0.060 * *	-0.013	0.167 * *	0.013	0.037 * *	0.025	0.043 * **	0.036
	(0.027)	(0.027)	(0.061)	(0.048)	(0.013)	(0.061)	(0.010)	(0.033)
*Pilot*Post*	0.078	0.011	0.166 * *	0.046	0.034 *	0.009	0.031 * *	0.062
	(0.046)	(0.034)	(0.073)	(0.041)	(0.015)	(0.067)	(0.014)	(0.037)
Pilot	0.071 *	0.045	-0.007	0.005	0.055 * **	0.028	0.082 * **	-0.106 * **
	(0.036)	(0.033)	(0.068)	(0.037)	(0.016)	(0.056)	(0.014)	(0.028)
Observations	1756	1285	1057	2157	10,240	5528	9760	6007
Adj R-squared	0.130	0.156	0.176	0.123	0.199	0.223	0.210	0.215
Controls	YES	YES	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel C: Impact on the propensity to repurchase shares by CEO incentives

Dependent variable *P (Repurchase)*

	% Options		PPS		OptionDelay		OC_Firm5	
	Low (1)	High (2)	Low (3)	High (4)	0 (5)	1 (6)	0 (7)	1 (8)
*Pilot*During*	-0.126	-0.126	-0.061	0.086	-0.047	0.027	-0.014	0.020
	(0.070)	(0.070)	(0.053)	(0.058)	(0.036)	(0.023)	(0.038)	(0.018)
*Pilot*Post*	-0.168 * *	-0.168 * *	-0.046	0.169	0.042	0.048	0.067 *	0.034
	(0.070)	(0.070)	(0.055)	(0.107)	(0.050)	(0.033)	(0.033)	(0.033)
Pilot	0.070 * *	0.070 * *	0.023	-0.085	-0.072 *	0.053 * *	0.020	0.046 * *
	(0.031)	(0.031)	(0.045)	(0.058)	(0.035)	(0.018)	(0.026)	(0.017)
Observations	1285	1285	2157	1057	5616	10,295	6080	9830
Adj R-squared	0.119	0.119	0.071	0.116	0.117	0.100	0.109	0.103
Controls	YES	YES	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel D: Impact on the propensity to pay dividends or repurchases by CEO incentives

(*continued on next page*)

Table 9 (*continued*)

Panel D: Impact on the propensity to pay dividends or repurchases by CEO incentives								
Dependent variable *P (TotalPayout)*								
	% Options		PPS		OptionDelay		OC_Firm5	
	Low	High	Low	High	0	1	0	1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable *P (TotalPayout)*								
	% Options		PPS		OptionDelay		OC_Firm5	
	Low	High	Low	High	0	1	0	1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
*Pilot*During*	-0.086	-0.086	0.044	0.128 * *	-0.022	0.019	0.006	0.017
	(0.0700)	(0.070)	(0.039)	(0.046)	(0.035)	(0.017)	(0.042)	(0.017)
*Pilot*Post*	-0.058	-0.058	0.069	0.175 *	0.046	0.046 *	0.103 * *	0.032
	(0.067)	(0.067)	(0.060)	(0.080)	(0.055)	(0.023)	(0.037)	(0.025)
Pilot	0.053	0.053	-0.003	-0.009	-0.032	0.079 * *	-0.071 * *	0.099 * **
	(0.031)	(0.031)	(0.040)	(0.057)	(0.034)	(0.018)	(0.025)	(0.020)
Observations	1285	1285	2157	1057	5616	10,295	6080	9830
Adj R-squared	0.134	0.134	0.108	0.113	0.165	0.160	0.167	0.164
Controls	YES	YES	YES	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

measures to divide firm-year observations in our cross-sectional analysis.

Our findings using CEO incentive and overconfidence measures are reported in Table 9. Panel A shows that pilot firms with fewer stock options, lower pay-performance sensitivity, and lower degree of overconfidence smooth less, as indicated by their higher adjustment speed. The findings in Panel B show that the effect of an increase in the prospect of short selling on the propensity to increase dividends is more pronounced for firms with a lower percentage of stock options, lower pay-performance sensitivity, and lower degree of overconfidence. Thus, the increase in the likelihood of short selling pressure has a more pronounced impact when managers have poorly aligned incentives and low overconfidence levels. The results are less pronounced when using the propensity to repurchase shares or the propensity of total payout as the dependent variable.

7. Conclusion

We examine the impact of the stock-price formation process on dividend smoothing policy. Specifically, we investigate the effect of the elimination of short-selling restrictions on dividend smoothing. We use the Regulation SHO pilot program to capture an exogenous shock to short-selling activity, in which short-selling restrictions are eliminated. We find that the increase in the likelihood of short selling increases the propensity to pay dividends. Furthermore, pilot firms are more likely to increase dividends during the pilot program while decreasing dividends after the program ends, indicating that short-selling pressure significantly impacts dividend policy. Importantly, there is a significant decline in firms smoothing of dividends. For robustness, we examine the impact on repurchases and total payout and find that the impact of Regulation SHO is less pronounced for repurchases. Our results define a new channel through which stock-price dynamics within the secondary stock market impact corporate decisions.

In justifying our findings, we examine signaling and agency-based explanations of payout policy, and we find that the impact of short selling on dividends or repurchases is stronger for firms with higher information asymmetry and higher firm performance. Additionally, the effect of short-selling activity on payout policy is greater for firms with weaker governance and poorly aligned CEO incentives.

This paper contributes to the short-selling literature by providing evidence of the impact of an increase in the prospect of short-selling activity on payout policy. In particular, our findings improve the understanding of the effect of the secondary stock market on corporate decisions, and they add to the literature examining determinants of payout policy, especially dividend smoothing, thus having relevant implications for investors, firms, and regulators.

Conflict of interest

None.

Appendix A. Variable definitions

Variable	Definition
Dividend and Dividend Smoothing Measures	
P(Dividend)	Equal to one if dividend per share is strictly positive and zero otherwise
P(Initiate)	Equal to one if a firm has a non-zero dividend payment in year *t* − *1* and zero dividend payment in year *t* and zero otherwise.
P(Increase)	Equal to one if the level of dividend payment in year *t* is greater than year *t–1* and zero otherwise.
P(Omit)	Equal to one if a firm has a zero-dividend payment in year *t* − *1* and non-zero dividend payment in year *t*.
P(Decrease)	Equal to one if the level of dividend payment in year *t* is less than year *t* – *1* and zero otherwise
Earnings	Income before extraordinary items
Dividend Change	Change in dividend for firm i from fiscal year t-1 to fiscal year t
Speed of adjustment	Response of payout policies to temporary earnings shocks
Target Payout Ratio	Estimation of what total dividend should be
Other Payout Measures	
P(Repurchase)	Equal to one if the difference between stock repurchases and preferred shares outstanding is strictly positive and zero otherwise
P(TotalPayout)	Equal to one if total payout is strictly positive and zero otherwise

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Variable	Definition
Indicator Variables	
Pilot	Equal to one if a firm was selected as a pilot firm and zero otherwise
Pre	Equal to one if the fiscal year end falls within 2001 and 2003 (inclusive), and zero otherwise
During	Equal to one if the fiscal year end falls within 2005 and 2007 (inclusive), and zero otherwise
Post	Equal to one if the fiscal year end falls within 2008 and 2010 (inclusive), and zero otherwise
Control Variables	
Market-to-book	Ratio of market value of equity divided by the book value of equity.
Income	Difference between EBIDTA and capital expenditures
Leverage	Ratio of sum of short-term and long-term debt to book value of total assets of firm
Size	Natural logarithm of sales
Volatility of FCF	Volatility of free cash flow

Appendix B. Impact of Regulation SHO pilot program on dividends and repurchases

This table reports the estimation of the differences-in-differences model that examines the impact of Regulation SHO on dividends or repurchase shares. In Panel A, we replicate the results of Chen, Zhu and Chang (2018) for both the full and small sample of firms. The subsequent tables examine the impact of Regulation SHO on dividends (Panel B), repurchases (Panel C) and total payout (Panel D) after controlling for the busted randomization by Litvak, Black and Yoo (2016). *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the fiscal year end falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the fiscal year end falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Industry (Fama-French 48 industry classification) and year fixed effects are included as specified but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2001–2010 (2004 omitted). * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Panel A: Replication of Chen, Zhu and Chang (2018)

Dependent Variable *Dividends*			*Repurchases*		*Total Payout*	
	(1) Full	(2) Small	(3) Full	(4) Small	(5) Full	(6) Small
*Pilot*During*	8.509	1.731 * **	-29.70	-0.021	-21.19	1.710
	(8.194)	(0.454)	(25.47)	(1.498)	(27.60)	(1.586)
*Pilot*Post*	29.91 * *	3.788 * *	-23.99	0.883	5.925	4.671 *
	(12.88)	(1.274)	(26.80)	(1.835)	(32.23)	(2.156)
Pilot	-10.06	-0.612 *	-1.774	-2.322 * *	-11.84	-2.934 * *
	(8.231)	(0.320)	(12.68)	(1.005)	(17.34)	(1.064)
Observations	14,362	7128	14,362	7128	14,362	7128
Adj R-squared	0.528	0.052	0.323	0.158	0.471	0.190
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Panel B: Impact on dividends using the busted randomization

Dependent variable *Dividends*	(1)	(2)	(3)	(4)	(5)
	Pilot vs. Partly Treated	Partly Treated vs. True Controls	Pilot vs. Original Controls	Pilot vs. True Controls	Pilot vs. True Controls (ln(mrktcap) < 7.8)
*Pilot*During*	13.35	-20.65	6.817	5.061	1.773 * *
	(11.86)	(12.25)	(8.259)	(6.326)	(0.781)
*Pilot*Post*	32.98	-25.78	30.24 * *	25.83 * *	4.975 * **
	(19.70)	(14.91)	(12.70)	(8.508)	(1.177)
Pilot	40.23 * *	-80.87 * **	-13.68	-37.89 * *	-0.204
	(16.88)	(25.10)	(8.109)	(13.53)	(0.398)
Observations	8098	9363	14,362	11,108	9593
Adj R-squared	0.552	0.547	0.547	0.598	0.078
Controls	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel C: Impact on repurchases using the busted randomization

Dependent variable *Repurchases*	(1)	(2)	(3)	(4)	(5)
	Pilot vs. Partly Treated	Partly Treated vs. True Controls	Pilot vs. Original Controls	Pilot vs. True Controls	Pilot vs. True Controls (ln(mrktcap) < 7.8)
*Pilot*During*	-219.4 * **	244.8 * **	-28.70	67.73 * *	-0.445
	(57.11)	(61.40)	(25.30)	(24.32)	(0.962)
*Pilot*Post*	-94.21	51.61	-23.34	9.342	3.294

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Panel C: Impact on repurchases using the busted randomization					
Dependent variable *Repurchases*					
	(1)	(2)	(3)	(4)	(5)
	(60.61)	(65.53)	(24.51)	(31.77)	(2.983)
Pilot	127.3 * *	-192.4 *	0.227	-41.55 * **	1.033
	(48.02)	(88.61)	(12.52)	(12.84)	(0.593)
Observations	8098	9363	14,362	11,108	9593
Adj R-squared	0.327	0.317	0.329	0.420	0.102
Controls	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel D: Impact on total payout using the busted randomization					
Dependent variable *Total Payout*					
	(1)	(2)	(3)	(4)	(5)
	Pilot vs. Partly Treated	Partly Treated vs. True Controls	Pilot vs. Original Controls	Pilot vs. True Controls	Pilot vs. True Controls (ln(mrktcap) < 7.8)
*Pilot*During*	-206.1 * **	224.1 * **	-21.88	72.79 * *	1.328
	(63.15)	(67.13)	(27.78)	(27.64)	(1.150)
*Pilot*Post*	-61.24	25.83	6.897	35.17	8.270 *
	(69.79)	(65.86)	(29.95)	(32.11)	(3.773)
Pilot	167.5 * *	-273.3 * *	-13.45	-79.44 * **	0.830
	(56.39)	(105.8)	(17.19)	(20.17)	(0.695)
Observations	8098	9363	14,362	11,108	9593
Adj R-squared	0.473	0.441	0.475	0.606	0.127
Controls	YES	YES	YES	YES	YES
FF Industry FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Appendix C. Inclusion of Firm Fixed Effects

This table reports the estimation of the differences-in-differences model that examines the impact of Regulation SHO on changes in payout policy after controlling for the busted randomization (Litvak, Black and Yoo, 2016) and the inclusion of firm fixed effects. Panel A, B and C examine the impact on dividend changes. Panel D examines the impact on repurchases and total payout. *P(Dividends)* is one if a firm pays dividends and zero otherwise. *P(Initiate)* is one if a non-dividend paying firm initiates dividends and zero otherwise. *P(Increase)* is one if a dividend paying firm increases dividends and zero otherwise. *P(Omit)* is one if a dividend paying firm does not pay dividends and zero otherwise. *P(Decrease)* is one if a dividend paying firm decreases dividends and zero otherwise. *P(Repurchases)* is one if a firm repurchases shares and zero otherwise. *P(TotalPayout)* is one if a firm pays dividend or repurchases shares and zero otherwise. *Pilot* is equal to one if a firm was selected as a pilot firm and zero otherwise. *During* is equal to one if the fiscal year end falls within 2005 and 2007 (inclusive), and zero otherwise. *Post* is equal to one if the fiscal year end falls within 2008 and 2010 (inclusive), and zero otherwise. The control variables are income, size, leverage, market-to-book and volatility of free cash flow. Variables are defined in Appendix A. Firm fixed effects and year fixed effects are included as specified but unreported. Robust standard errors are clustered by both firm and year and reported in parentheses. The time period used is 2001–2010 (2004 omitted). * ** ,* *, and * denote the significance at the 1%, 5% and 10% levels respectively.

Panel A: Original control firms vs. Pilot firms					
Dependent Variable	*P (Dividend)* (1)	*P (Initiate)* (2)	*P (Increase)* (3)	*P (Omit)* (4)	*P (Decrease)* (5)
*Pilot*During*	0.010	0.002	0.015	-0.005	-0.010
	(0.013)	(0.004)	(0.015)	(0.003)	(0.009)
*Pilot*Post*	0.027	0.002	0.011	-0.005	0.015
	(0.017)	(0.006)	(0.018)	(0.008)	(0.017)
Observations	14,353	14,353	14,353	14,353	14,353
Adj R-squared	0.809	0.009	0.605	0.008	0.231
Controls	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel B: Partly treated firms vs True control firms					
Dependent Variable	*P (Dividend)* (1)	*P (Initiate)* (2)	*P (Increase)* (3)	*P (Omit)* (4)	*P (Decrease)* (5)
*Pilot*During*	0.070 * **	0.012 *	0.053 * *	0.004	0.024
	(0.019)	(0.006)	(0.020)	(0.003)	(0.021)
*Pilot*Post*	0.066 * *	-0.007	-0.006	0.004	0.078 * **
	(0.024)	(0.007)	(0.029)	(0.011)	(0.023)
Observations	9359	9359	9359	9359	9359

(*continued on next page*)

(continued)

Panel B: Partly treated firms vs True control firms					
Dependent Variable	*P (Dividend)* (1)	*P (Initiate)* (2)	*P (Increase)* (3)	*P (Omit)* (4)	*P (Decrease)* (5)
Adj R-squared	0.807	0.004	0.606	0.005	0.238
Controls	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel C: Pilot vs True controls (ln (market cap) < 7.8)					
Dependent Variable	*P (Dividend)* (1)	*P (Initiate)* (2)	*P (Increase)* (3)	*P (Omit)* (4)	*P (Decrease)* (5)
*Pilot*During*	0.030 *	0.012 * *	0.031 *	-0.003	-0.004
	(0.016)	(0.005)	(0.015)	(0.004)	(0.011)
*Pilot*Post*	0.053 * *	0.008	0.021	0.001	0.037 *
	(0.020)	(0.008)	(0.018)	(0.010)	(0.018)
Observations	9573	9573	9573	9573	9573
Adj R-squared	0.793	0.011	0.578	0.013	0.268
Controls	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Panel D: Impact on repurchases and total payout						
Dependent variable	P (*Repurchases*)			*P (Total Payout)*		
	(1)	(2)	(3)	(4)	(5)	(6)
	Original Controls vs. Pilot	True Controls vs. Partly Treated	True Controls vs. Pilot (ln(mrktcap) < 7.8)	Original Controls vs. Pilot	True Controls vs. Partly Treated	True Controls vs. Pilot (ln(mrktcap) < 7.8)
*Pilot*During*	-0.008	0.116 * **	-0.004	0.007	0.034	0.013
	(0.020)	(0.033)	(0.028)	(0.017)	(0.028)	(0.026)
*Pilot*Post*	0.051 *	-0.015	0.025	0.036	-0.031	0.031
	(0.026)	(0.041)	(0.032)	(0.024)	(0.028)	(0.031)
Observations	14,353	9359	9573	14,353	9359	9573
Adj R-squared	0.403	0.413	0.372	0.537	0.540	0.509
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

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