Can Short Selling Constrain the Shift Between Accrual-based and Real Earnings Management?

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Abstract

We study the causal effects of short selling on both accrual-based and real earnings management by exploiting an exogenous shock to short selling costs under SEC Regulation SHO's pilot program. We find that the removal of short selling constraints leads to a reduction in discretionary accruals and, more importantly, a simultaneous reduction in real earnings management. Such disciplining effect on real earnings management is more pronounced when the cost associated with accrual earnings management is relatively high and managers are more entrenched. Furthermore, we also find that the effect is stronger in firms with high analyst coverage. Given prior findings that firms shift from accrual-based to real earning management after the increases in analyst coverage, our evidence suggests that short selling is superior to security analyst in constraining earnings management in that it does not lead to a shift from accrual-based earnings management to real earnings management.

1. Introduction

Missing analysts' forecasts or reporting quarterly losses are often accompanied by significant negative market responses. These negative market responses can put great pressure on firm managers because they can be the start of a downward spiral that eventually endangers the job security of these managers. As a result, it is well documented that managers often strategically manipulate reported earning numbers to mislead the market to mitigate such negative impacts on them. They can do so either through the manipulation of accruals at the end of an accounting period (i.e. accrual earnings management) or through real activities manipulation at the beginning and during an accounting period (i.e. real earnings management). Both types of manipulations reduce the usefulness of accounting information to investors and in some cases can result in huge losses for misled investors. A large existing literature has studied how various internal and external governance mechanisms can help to constrain the two forms of earnings manipulation in isolation. However, managers are known to shift between the two methods of earnings management according to the relative cost of them when governance environment changes (Zang, 2012). For example, Cohen et al. (2008) find that the level of real activities manipulation increased significantly after the passage of SOX, suggesting a switch from accrual-based to real earnings management after SOX. More recently, Irani and Oesch (2016) find that the loss of analyst coverage due to brokerage closures or mergers led firms to switch from real earnings management to accrual-based earnings management. This raises the question of what governance mechanisms can constrain such shifts. Few studies have addressed this questions so far. In this paper, we fill this void and examines whether external monitoring by short sellers can constrain the shift.

Previous studies have documented that short sellers are able to detect misconduct of firms and initiate or speed up price tumbling process by uncovering the negative information of firms in the market (Karpoff and Lou, 2010; Hirshleifer, Teoh, and Yu, 2011). Compared with accrual

manipulations, real activities manipulations do not violate accounting rules and standards and are usually more difficult to detect. According to the survey conducted by Graham et al. (2005), CFOs prefer to engage in real activities manipulation rather than accrual manipulation because the former is more difficult to be detected. This can explain why there are increases in real earning manipulations after SOX and increases in analyst coverage. However, short seller monitoring can be especially effective at constrain real activities manipulation when compared with other governance mechanisms, such as monitoring by securities analysts, and thus has the potential to constrain the shift between accrual-based and real earnings management. This is because, compared with accrual-based earnings manipulations, real activities manipulations are typically done by sacrificing a firm's long-run strategy and investments and thus have a negative long-run effect on firm value. Graham et al. (2005) report that 78% of surveyed CFOs stated that they would decrease R&D, advertising, and maintenance expenditures to meet a higher earnings target, while 55% said that they would postpone a new project. Since short sellers have expertise in evaluating the effects of real activity changes on firm value and can profit from trading ahead of the negative long-run effect is being impounded into a firm's stock price, they have strong incentives to detect real earnings management. Their shorting activities in turn speed up the incorporation of the negative news into the stock prices of the manipulation firms. Drops in stock prices lower the value of managers' equity interests in their firms. The price tumbling process initiated by short sellers can also lead to more severe disciplinary actions, such as forced turnover, against managers. Hence, the threat of short selling could push managers to avoid real activities manipulations that would damage a firm's value in the long run.

One empirical challenge in identifying a causal effect of short selling on corporate behaviour is that omitted variable biases or reverse causality can confound the interpretation of any relation between short selling cost and earnings management. To overcome the endogeneity issues, we use the randomized experiment under Regulation SHO that temporarily removed the

short sale price tests for one third of the firms (pilot firms) in Russell 3000 index and thus introduced an exogenous reduction in short selling costs for these pilot firms. In July 2004, the Securities and Exchange Commission (SEC) established a pilot program to test the effect of the removal of short selling constraints on financial market. Under this pilot program, the stocks in the Russell 3000 index were ranked by trading volume within each stock exchange. In each group, every third stock was selected as a pilot stock. During the experiment period (May 2, 2005 to June 30, 2007), these pilot stocks were exempted from short sale price tests. Specifically, the uptick rule, which was adopted in 1935 to prevent bear raids by short sellers in a declining market, was eliminated for pilot stocks during the experiment. Under uptick rule, short sellers are only allowed to trade when the price exceeds the most recent trading price, which imposes significant costs on the short sellers. According to Fang, Huang, and Karpoff (2015), this randomized experiment provides us an attractive setting to examine the effect of short selling on earnings management for the following reasons. Firstly, the pilot program represents an exogenous shock to the cost of short selling for those randomly selected firms. There is no evidence showing that any individual firms could know whether it would be selected as pilot firms or not before the SEC made announcement. Secondly, since this experiment exempts pilot firms from short sale price tests, the informed traders could trade on the negative information of these pilot firms at a lower cost (Diether, Lee, and Werner, 2009). As a result, the exposure to short selling threat increases in pilot firms relative to non-pilot firms, which eliminates the need to directly measure the short selling costs in our test. Finally, this experiment facilitates difference in differences (DiD) analysis of the impact of short selling on earnings management. We can mitigate the concerns about the omitted variables by using DiD analysis to control the common time trends for both pilot and non-pilot firms.

In our baseline results, we examine changes in both accrual and real earnings management in pilot firms relative to non-pilot firms from before to after the treatment period. Our DiD estimates indicate that after the removal of short sale price tests, there is a significant drop in

both types of earnings management in pilot firms. Specifically, the reduction in real earnings management is driven by a drop in overproduction and discretionary expenses. This evidence suggests that firms subjecting to more scrutiny from short sellers are less likely to engage in both accrual and real earnings management simultaneously.

We then further explore our baseline results though cross-sectional analysis. First, we assess how the costs of one form of earnings management would affect short selling disciplining effects on the other form of the earnings management. Park (2017) document that the positive relation between real earnings management and subsequent short interest is more pronounced when the costs associated with accrual earnings management are high. Zang (2012) finds that firms' earnings management decision depends on the relative costs of accrual earnings management and real earnings management. When one of the approaches is relatively more costly, managers would rely more on the other one as substitute. She documents that accrual earnings management is more constrained when firms face heightened scrutiny from a high-quality auditor. On the other hand, real earnings management is more constrained when firms are in poor finance health condition or are experiencing a high-level monitoring from institutional investors. Following prior studies, we split the sample based on these relative costs of the earnings management. Our results show that the disciplining effects on the real earnings management is more pronounced in Big 4-audited firms, firms with lower institutional ownership and firms in good financial health. On the contrary, the effects on the accrual earnings management is stronger in the non-Big 4 audited firms, firms with higher institutional ownership and firms with poor finance health status.

Next, we compare the effectiveness of short selling threat and security analysts in terms of monitoring earnings management. Prior literature shows that under the monitoring pressure from securities analysts, managers tend to use less accrual-based tools but more real activity manipulations to meet the earnings target (Irni and Oesch 2016). Their evidence suggests that as one of the external monitoring mechanisms, security analysts are effective in constraining

accrual earnings management but not so much in constraining real earnings management. In this cross-sectional analysis, we assess how the short sellers disciplining effects on earnings management varies with analyst coverage. We find that the effects of the short selling on real earnings management is more pronounced in the firms with higher-level analyst coverage, while the effects on accrual earnings management concentrates in the firms with lower-lever analyst coverage. Our results are consistent with Irni and Oesch (2016). They show that when the firms face high level monitoring from security analysts, they would rely more on real earnings management. Our results suggests that short selling, as another type of external monitoring mechanism, can make up for the deficiencies of analyst monitoring in constraining real earnings management. The results from this analysis indicate that as corporate external monitors, the monitoring function of short sellers are more effective than securities analysts in terms of constraining real earnings management.

We also investigate how short selling threat varies with internal governance mechanisms in reducing earnings management. Previous literature has shown that high levels of earnings management are usually associated with poor internal corporate governance. We use the G-index of Gompers, Ishii, and Metrick (2003) to proxy for the quality of internal corporate governance. The G-index is constructed to measure the level of shareholder rights. Higher G-index values indicate weaker shareholder rights and thus greater managerial entrenchment and poorer internal corporate governance. We expect that the monitoring effects of short seller would be stronger in the firms with poor internal governance. The empirical results are consistent with our expectation on the real earnings management. Specifically, we find that the short seller disciplining effect on real earnings management is more pronounced in firms with higher G-index values, but we do not find the disciplinary effects of short sellers on accrual-based earnings management vary with the strength of internal corporate governance.

Finally, we reassess the impact of the Regulation SHO's pilot program on short sales activity and test how the firms' engagement in earnings management would affect short sales activities

during the pilot program. Following Grullon, Michenaud, and Weston (2015), we focus on the event window around the announcement of Regulation SHO's pilot program. Specifically, we adopt the sample period from one year before the announcement date (i.e. July 28, 2004) to the nine months after the announcement to assess the effect of the removal of short selling tests on firms' monthly short interest and monthly abnormal short interest[1]. Our DiD estimates are consistent with the results in Grullon, Michenaud, and Weston (2015) that both monthly short interest and monthly abnormal short interest of pilot firms increase relative to the non-pilot firms from before to after the announcement. Furthermore, we carry out the subsample analysis based on the firms' earnings management status in the year before the announcement to assess whether short sellers, as well-informed and sophisticated investors, could target those firms with high level accrual or real earnings management. Our results show that the increase of the short sales activity mainly concentrates on those firms with high level real earnings management or high level accrual earnings management, which is consistent with short sellers' monitoring role on both earnings management approaches in our previous results.

This paper makes two main contributions to the literature. First, this study adds to the empirical literature on the interaction between short sellers and earnings management. Although previous studies find a relation between short selling and accrual earnings management, we know little about how exposure to short selling threats affects real earnings management. Our findings complement existing evidence in this strand of literature by showing that short selling also mitigates managers' incentives for real activities manipulation and thus provide a more complete picture of how short sellers affect earnings management. Our study also extends our understanding of short sellers' sophistication. Zang (2012) indicates that managers would determine the earnings management strategy based on relative costs of each approach. Our results provide evidence that short sellers could identify such cost-based

[1] Following Grullon, Michenaud, and Weston (2015), we stop this analysis before the actual implementation date of the Regulation SHO's pilot program to exclude other confounding effects.

substitution relation between accrual and real earnings management and target on the one that is more likely to be used by firms.

Second, this paper contrasts the effectiveness of the monitoring function of short sellers and securities analysts. Irani and Oesch (2016) suggests that security analyst is effective in constraining accrual earnings management but limited on monitoring real earnings management. Our study suggests that short selling threat appears to be a superior mechanism in constraining earnings management to several other mechanisms that have been studied in that it can constrain both accrual-based earnings management and real earnings management simultaneously.

2. Identification, sample construction and key variables construction

2.1 Identification

In attempting to study the effect of short selling on corporate behavior, a major concern is the endogenous nature of short sales activities. To tackle the endogeneity problem, we exploit a quasi-natural experiment, Regulation SHO, which eliminated short sale price tests for randomly selected stocks to examine the effect of the removal of short selling constraints on earnings management. The timeline for Regulation SHO pilot program is shown as follows. The SEC randomly selected pilot firms on June 23, 2004. Every third stock from Russell 3000 index ranked by trading volume within each stock exchange was selected as a pilot stock. On July 28, 2004, the SEC made an announcement which disclosed the details about the pilot program. This experiment effectively started on May 2, 2005 and ended on July 6, 2007 within which pilot stocks were temporarily exempted from short selling constraints. After July 2007, the SEC removed short sale price tests for all exchange listed stocks. One reasonable concern about this random experiment could be that firms may not care about this pilot program because the uptick rule which was suspended in this experiment only prevents short sales in a declining market. However, existing studies provide evidence that firms do care about the removal of the uptick rule. For example, the survey conducted by NYSX in 2008 shows that 85% of corporate

top executives express the support for the reinstitution of uptick rule as soon as possible. Additionally, Lamont (2012) finds that firms try to reduce the exposure to short sellers by deliberately switching stock exchanges to seek shield from the uptick rule. Therefore, this pilot program could be regarded as an ideal exogenous shock for our study as firms appear to be sensitive to the impact of the removal of short selling constraints.

To empirically test firms' reaction to the removal of short selling constraint during the Regulation SHO, we implement our DiD analysis by using following panel regression:

$$EM_{i,t} = \alpha + \beta_1 \times Pilot_i + \beta_2 \times Pilot_i \times During_t + \beta_3 \times Pilot_i \times Post_t + \delta X_{i,t} + Year\ FE + \varepsilon_{i,t} \quad (1)$$

On the left-hand side of Equation (1), dependent variable $EM_{i,t}$ represents the level of a particular type of earnings management approaches for firm i over the fiscal year t. On the right-hand side of Equation (1), $Pilot_i$ is a dummy variable indicating pilot firm. $During_t$ is an indicator for the treatment period from fiscal year end from January 1, 2005 to December 31, 2007. $Post_t$ is an indicator variable for the period after the end of the pilot program which equals one if the fiscal year end falls between January 1, 2008 and December 31, 2010. The vector X represents the control variables including firm size measured by natural logarithm of market capitalization, ROA measured by net income divided by total assets, and market to book ratio measured by natural logarithm of a firm's book value divided by its market capitalization. We also include year fixed effect in the regression.

Our primary focus in Equation (1) is β_2, the coefficient of the interaction term ($Pilot_i \times During_t$), which measures the DiD effect, i.e. changes of earnings management level in pilot firms relative to non-pilot firms from before to after the treatment period. A negative and statistically significant β_2 would be evidence that after the removal of short selling constraints, managers are less likely to engage in earnings management.

2.2 Sample construction

Our main dataset starts from the official membership list of firms included in the Russell 3000 index as of June 30, 2004.[2] We merge it with the list of pilot firms announced on July 28, 2004 by the SEC. We only keep the stocks listed on the NYSE, AMEX, or NASDAQ NM. We also delete firms in the financial service (SIC 6000-6999) and utilities (SIC 4900-4949) industries. We merge this dataset with Compustat, and CRSP to generate other firm characteristics. The definition of each variable will be disclosed in the Appendix. Our final sample, created using data from 2004, contains 2,178 firms (1,466 control and 712 pilot firms). In our tests, we are going to examine the effect of the removal of short selling constraints on both accrual and real earnings management. We select sample period from 2001 to 2010 by following Fang, Huang, and Karpoff (2015). Additionally, the pilot program was announced in 2004, therefore it is unclear whether 2004 should be classified as part of experiment period or pre-treatment period. Thus, we omit 2004 in our sample.

2.3 Key variables construction

2.3.1 Real earnings management

Roychowdhury (2006) defines real earnings management (REM) as the deviation from firm normal business practices, motivated by managers' desire to mislead shareholders into believing that certain financial goals have been achieved in the normal course of operation. Compared with accrual earnings management, real earnings management directly affects cash flow and could often affect firm value. Certain level of manipulation of real activities, such as price discounts and the reduction of discretionary expenses, could be the optimal choices to help firms achieve short term targets without hurting firms' future benefits. However, when managers extensively engage in such activities more than the normal operation level for the purpose of gaining private benefits of meeting certain short-term targets, such manipulations can hurt the firm in the long run (Cohen and Zarowin, 2010).

[2] We are grateful to Russell Investments for providing the list of 2004 Russell 3000 index firms.

Based on Dechow et al. (1998) and Roychowdhury (2006), we measure the real earnings management by focusing on three real activities: sales manipulation, overproduction, and reduction of discretionary expenses.

A. Sales manipulation

Following Roychowdhury (2006), managers could generate additional sales from next year into current year and temporarily boost sales volume by offering price discounts or more lenient credit terms. Such favourable price policies could lead to higher total earnings recorded in the financial reports. However, the net cash inflow per sale will be lower than the normal operation level due to the decline in the profit margins. Following previous literature, sales manipulation through price discounts or more lenient credit terms is measured by abnormal level of cash flow from operations (CFO), which is estimated as the residual from the following cross-sectional OLS regression for each industry-year from 2001 to 2010:

$$\frac{CFO_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{SALES_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{\Delta SALES_{i,t}}{Asset_{i,t-1}} + \varepsilon_{i,t} \qquad (2)$$

where $CFO_{i,t}$ is the cash flow from operation in fiscal year t ($OANCF_{i,t}$ minus $XIDOC_{i,t}$). $SALES_{i,t}$ is the net sales for firm i in year t. $\Delta SALES_{i,t}$ is the change in net sales from year $t-1$ to t. $Asset_{i,t-1}$ is the total assets for firm i in year $t-1$. The regressions are run separately for each year and Fama-French 48-industry code with a minimum of 15 observations. Following Cohen and Zarowin (2010), the abnormal level of CFO (RM_CFO) is measured as the residual from (2) multiplied by -1 because the lower the cash flow the more likely the firm has used price discounts or lenient credit terms to boost sales and thus manipulated up current period earnings.

B. Overproduction

Following Roychowdhury (2006), managers of manufacturing firms could lower fixed costs per unit by overproducing more inventories than necessary to eventually increase reported earnings. Overproduction allows fixed overhead costs to be spread over a large number of units, which may lead to the increase in operating margins. Specifically, as long as the reduction in

the fixed costs per unit is not offset by the increase in inventory holding costs per unit, the reported COGS could be written down. However, in spite of the increase in reported earnings in the short period, overproduction generates excess inventories that have to be sold in the following periods and leads to higher inventory holding costs on the company, which could impose more severe burden on firms' future operation. Following previous literature, real earnings management though overproduction is measured by abnormal level of production costs (RM_PROD), which is estimated as the residual from the following cross-sectional OLS regressions for each industry-year from 2001 to 2010:

$$\frac{PROD_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{SALES_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{\Delta SALES_{i,t}}{Asset_{i,t-1}} + \beta_4 \frac{\Delta SALES_{i,t-1}}{Asset_{i,t-1}} + \varepsilon_{i,t} \quad (3)$$

where $PROD_{i,t}$ is defined as the sum of the cost of golds sold in year t ($COGS_{i,t}$) and the change in inventory from year $t-1$ to year t ($\Delta INV_{i,t}$). The higher the residual the more likely the firm has engaged in overproduction to manipulate down the cost of goods sold so it can report a higher operating margin.

C. Reduction of discretionary expenses

The third real activity to increase earnings is to reduce discretionary expenses such as R&D, advertising expenditures, and maintenance costs. Roychowdhury (2006) points out that managers are willing to reduce these discretionary expenses because such expenditures cannot generate income immediately. However, certain discretionary costs such as R&D, employee training, and maintenance are important for company's future profits. Extensively engaging in the reduction of such expenses would harm company's long-term benefits. Following previous literature, real earnings management through the reduction of discretionary expenses is measured by abnormal level of discretionary expenses, which is estimated as the residual from the following cross-sectional OLS regressions for each industry-year from 2001 to 2010:

$$\frac{DISX_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{SALES_{i,t-1}}{Asset_{i,t-1}} + \varepsilon_{i,t} \quad (4)$$

where $DISX_{i,t}$ is measured as the sum of R&D ($XRD_{i,t}$), advertising expenses ($XAD_{i,t}$), and SG&A expenses ($XSGA_{i,t}$) for firm i in year t. Following Cohen and Zarowin (2010), the abnormal level of discretionary expenses (RM_DISX) is measured as the residual from (4) multiplied by -1 because the lower the discretional expenses the more likely the firm has cut advertising, R&D, and SG&A expenses unusually to manipulate up current period earnings.

Finally, we also adopt two aggregate measures of real earnings management following Zang (2012), Cohen and Zarowin (2010), and Irani and Oesch (2016).[3] That is

$$RM1 = RM\_PROD + RM\_DISX,$$

$$RM2 = RM\_CFO + RM\_DISX.$$

Since RM_CFO and RM_DISX are defined as residuals from equations (2) and (4) multiplied by -1, the higher the values of $RM1$ and $RM2$the more likely that firm has engaged in a combination of these real activities manipulations. We recognize that aggregating the individual measures may dilute any results when the individual proxies have different implications for the earnings in the year. Hence, we report results corresponding to both the two aggregate measures as well as the three individual measures.

2.3.2 Accrual earnings management

We measure accrual earnings management by using modified Jones (1991) model (Dechow et al., 1995). Specifically, we first estimate the following cross-sectional model within each fiscal year and Fama-French 48 industry to obtain the coefficients:

$$\frac{TA_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{\Delta REV_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{PPE_{i,t}}{Asset_{i,t-1}} + \varepsilon_{i,t} \qquad (5)$$

where $TA_{i,t}$ is the total accruals for firm i in year t, which is calculated as earnings before extraordinary items and discontinued operations minus operating cash flows for fiscal year t; $\Delta REV_{i,t}$ denotes the change in the sales revenue from year $t-1$ to year t; and $PPE_{i,t}$ is the

[3] Following Cohen and Zarowin (2010) and Roychowdhury (2006), we do not combine RM_CFO and RM_PROD since the same activities could lead to abnormally low CFO and high production costs simultaneously. Thus, aggregating RM_CFO and RM_PROD would lead to double counting problem.

gross value of property, plant, and equipment at the end of year t. Similar to the real earnings management construction, we require at least 15 observations to perform each cross-sectional estimation.

Next, the estimated coefficients from Equation (5) are used in the following model to estimate the normal level of the accruals ($\frac{NA_{i,t}}{Asset_{i,t-1}}$):

$$\frac{NA_{i,t}}{Asset_{i,t-1}} = \hat{\beta}_1 \frac{1}{Asset_{i,t-1}} + \hat{\beta}_2 \frac{\Delta REV_{i,t} - \Delta AR_{i,t}}{Asset_{i,t-1}} + \hat{\beta}_3 \frac{PPE_{i,t}}{Asset_{i,t-1}} \qquad (6)$$

where $\Delta AR_{i,t}$ is defined as the change in receivables from year $t-1$ to year t; and other variables are the same as those defined in Equation (5). Our accrual earnings management measure $AM_{i,t}$ is defined as the difference between $\frac{TA_{i,t}}{Asset_{i,t-1}}$ and $\frac{NA_{i,t}}{Asset_{i,t-1}}$.

Table 1 Panel A shows the summary statistics of the full sample from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive) for the analysis of real earnings management and accrual earnings management. The mean values of abnormal CFO, abnormal production costs, abnormal discretionary expenses, and abnormal accruals are -0.014, -0.057, -0.077, and -0.012 respectively. Panel B compares the pilot and non-pilot firms' characteristics in the fiscal year 2003, the year immediately before the announcement year of the pilot program. As shown in table, there is no significant difference between pilot firms and non-pilot firms in terms of firm size, ROA, and market-to-book ratio. The difference of mean tests displayed in Panel B are all insignificant, which confirms that pilot stocks are randomly chosen in this experiment.

3 The Effects of Regulation SHO's pilot Program on Real earnings management and Accrual earnings management

In this section, we exam how the removal of short selling constraints impacts both real earnings management and accrual earnings management. Fang, Huang, and Karpoff (2015) and Massa, Zhang, and Zhang (2015) have shown that accrual earnings management decreases under the Regulation SHO's pilot program. However, given the substitution relation between

the real earnings management and accrual earnings management documented in the previous literature, it is unclear whether the short selling threat would mitigate managers' incentive to engage in both earnings management or managers would shift from accrual earnings management to real earnings management which is more difficult to detect. We follow the same methodology adopted by Fang, Huang, and Karpoff (2015), but our main interest is on the real earnings management.

3.1 Baseline results

Table 2 shows the results for the effects of pilot program on both real earnings management and accrual earnings management. Columns 1 and 2 report the effects of removal of short selling constraints on the aggregate real earnings management measures. The coefficients on the interaction term ($Pilot_i \times During_t$) are negative and statistically significant at 1% level, which indicates that pilot firms engage less in real earnings management than non-pilot firms during the pilot program. Specifically, the magnitude of the coefficients indicates that $RM1$ (i.e. the aggregate measures for real activities manipulation through overproduction and discretionary expense) and $RM2$ (i.e. the aggregate measures for real activities manipulation through sales manipulation and discretionary expense) are 1.8% and 1.1% lower for the pilot firms than for the non-pilot firms during the pilot program compared to before. Next, Columns 3 to 5 further investigate each real activity (RM_PROD, RM_CFO, RM_DISX) to understand how these three real activities function during the pilot program. From the coefficients on the interaction term ($Pilot_i \times During_t$), we can see that the reduction of the real activities manipulation is mainly driven by overproduction and discretionary expense. Comparing to the non-pilot firms, the abnormal production costs of pilot firms decrease by 0.6% (Column 3), and abnormal discretionary expenses of pilot firms increase by 1.1% (Column 5) during the pilot program.[4] The real earnings management through sales manipulation also decreases, while the

[4] Recall that abnormal CFO (RM_CFO) and abnormal discretionary expenses (RM_DISX) are measured by residuals from equations (2) and (4) multiplied by -1. Therefore, the negative (positive) coefficients on $Pilot_i \times During_t$ indicate that the

coefficient is not statistically significant (Column 4) [5]. Finally, Column 6 reports the effect of the removal of short selling constraints on accrual earnings management. The negative coefficient on the interaction term ($Pilot_i \times During_t$) indicates that the accrual earnings management is 0.7% lower for pilot firms than for non-pilot firms during the pilot program compared to before. The magnitude of this result is similar to Massa, Zhang, and Zhang (2015). Overall, the results in Table 2 suggests that after the removal of short selling constraints, managers discipline themselves by reducing both the real earnings management and accrual earnings management.

After July 2007, the SEC effectively removed short sale price tests for all listed stocks. Equation (1) also allows us to examine whether the pattern for real earnings management and accrual earnings management reverses after the end of the pilot program. The coefficients on the interaction term ($Pilot_i \times Post_t$) is for the test of reverse pattern. We find that the coefficients on this interaction term are negative and statistically significant at 5% level on $RM1$ (Column 1) but insignificant on $RM2$ (Column 2) and AM (Column 6). The significant result on $RM1$ is mainly driven by the abnormal discretionary expense (Column 5). The abnormal discretionary expense of pilot firms is still substantially higher than the non-pilot firms even after the pilot program. One possible explanation is that those pilot firms have been deeply investigated by short sellers during the pilot program and thus it is relatively cheaper for them to keep exploiting their existing information rather than digging new information on those non-pilot firms. As a result, it is possible that these pilot firms may still attract more attention than non-pilot firms even after the end of the experiment.

3.2 Cross-sectional analysis

abnormal CFO and abnormal discretionary expenses increase (decrease). The negative coefficients on $Pilot_i \times During_t$ mean the pilot firms reduce earnings management during the pilot program.

[5] The insignificant coefficient for the test of abnormal cash flows from operation may be explained by Roychowdhury (2006). Real activities impact the cash flow from operation in different directions (i.e. price discount, channel stuffing, and overproduction decreases cash flows from operation, while cutting discretionary expenses increases them) and thus the net effect is ambiguous.

The evidence so far indicates that both real earnings management and accrual earnings management are lower in the pilot firms compared to the non-pilot firms after the removal of short selling constraints, which is consistent with the disciplining role of short sellers. In this section, we further investigate the cross-sectional variation in short sellers' disciplining effects on both earnings management approaches. To control for the relation between two earnings management approaches, we further include AM, $RM1$ and $RM2$ as control variables when we carry out the following subsample analysis.[6]

3.2.1 Short selling and relative costs of earnings management

Both accrual and real earnings management are costly. Zang (2012) points out that the substitution relation between real earnings management and accrual earnings management depends on their relative costs. When one of the earnings management approaches is relatively more costly, firms would engage in more of the other. The relative costs associated with both approaches are different depending on firms' characteristics. Zang (2012) finds that accrual earnings management is more costly relative to the real earnings management if the firms are audited by one of the Big 4. On the other hand, real earnings management would be more costly if the firms are in a less healthy financial conditions or receive a higher level of monitoring from institutional investors. When managers engage in the earnings management, they would rely more on the approach with less cost. In this subsection, we split the sample based on these relative costs to further examine whether short seller disciplining effects would be more pronounced on one type of the earnings management when the cost associated with the other type is high.

A. Big 4 auditor vs. Non-big 4 auditor

Previous research shows that managers' engagement in accrual earnings management would be constrained in the firms audited by big 4 since the accrual earnings management is more

[6] The empirical results for the subsample analysis remain similar if we do not control for the relation between real earnings management and accrual earnings management.

likely to be detected by these more experienced audit firms (e.g., DeFond and Jiambalvo 1991, 1993; Becker et al. 1998; Francis et al.1999). We use a dummy variable $Big4$ which equals one if the firm's auditor is one of the big 4 to capture the level of the auditor scrutiny. The cost associated with accrual earnings management for the big 4 audited firms is relatively higher compared to non-big 4 audited firms. As a result, big 4 audited firms would rely more on the real earnings management. Therefore, we expect the short seller disciplining effects on real earnings management to be more pronounced in the big 4 audited firms given the accrual earnings management is more costly for these firms.

The results from this analysis are reported in Table 3. The main interest is still the coefficients on the interaction term $Pilot_i \times During_t$. Consistent with our predictions, the real earnings management for the pilot firms significantly drops relative to the non-pilot firms in the big 4 audited firms (Columns 1 and 3) during the pilot program, while the effects on the non-big4 audited firms are not statistically significant (Columns 2 and 4). On the contrary, the accrual earnings management for the pilot firms significantly drops relative to the non-pilot firms in the non-big 4 audited firms during the pilot program (Columns 6 and 8), while the effects on the big 4 audited firms are not statistically significant (Columns 5 and 7). Overall, our evidence suggests that the effects of Regulation SHO on real (accrual) earnings management is stronger in subsamples with big 4 (non-big 4) auditor.

B. High institutional ownership vs. Low institutional ownership

Prior research finds that institutional ownership is associated with lower level of real earnings management (Bushee, 1998 and Roychowdhury, 2006). They point out that institutional investors, as sophisticated shareholders, have a greater ability to analyse the long-run implications of real earnings management and constrain value-destroying real activities. Zang (2012) also documents that the cost associated with real earnings management is higher for the firms experiencing higher levels of monitoring from institutional investors. As a result,

the firms with higher institutional ownership would rely more on the accrual earnings management while the firms with lower institutional ownership would rely more on the real earnings management. We carry out the subsample analysis based on institutional ownership. Specifically, we use the firms' institutional ownership in 2003 (i.e. one year before the announcement of pilot program) to split the sample. We define an indicator variable that is equal to one if the institutional ownership of a firm is greater than the industry median, and zero otherwise. We expect the short seller disciplining effects on real earnings management to be more pronounced in the firms with low institutional ownership while the effects on the accrual earnings management to be more pronounced in the firms with high institutional ownership.

The results from this analysis are reported in Table 4. As indicated by the significant coefficients on the interaction term $Pilot_i \times During_t$ in Columns 2 and 4, real earnings management significantly drops for the pilot firms compared to the non-pilot firms in the subsample with low institutional ownership. However, since real earnings management has already been constrained in the firms with higher institutional ownership, the short seller discipling effect on real earnings management is not significant in this subsample (Columns 1 and 3). On the contrary, the accrual earnings management for the pilot firms significantly decreases compared to non-pilot firms in the subsample with high institutional ownership (Columns 5 and 7), while the effect is not statistically significant in the low institutional ownership (Columns 6 and 8). Overall, this evidence is consistent with our prediction that the effects of Regulation SHO on real (accrual) earnings management is stronger in subsamples with lower (higher) institutional ownership.

C. Good financial health vs. Poor financial health

Unlike accrual earnings management, real earnings management has direct cash flow consequences. As a result, firms with poor financial health need to afford higher marginal cost if the managers deviate from the normal business operation to engage in earnings manipulation. Zang (2012) finds that firms with poor financial health would rely more on the accrual earnings

management, while the firms with good financial health could rely more on the real earnings management. We carry out the subsample analysis based on firms' financial health status. Following Zang (2012), a modified version of Altman's Z-score (Altman 1968, 2000) is adopted to capture the firms' financial health: $ZSCORE_t = 0.3\frac{NI_t}{Asset_t} + 1.0\frac{Sales_t}{Asset_t} + 1.4\frac{Retained\ Earnings_t}{Asset_t} + 1.2\frac{Working\ Capital_t}{Asset_t} + 0.6\frac{Stock\ Price \times Share\ Outstanding_t}{Total\ Liabilities_t}$. We use the firms' Z-score in 2003 (i.e. one year before the announcement of pilot program) to split the sample. We define an indicator variable that is equal to one if the Z-score of a firm is greater than the industry median, and zero otherwise. We expect the short seller disciplining effects on real earnings management to be more pronounced in the firms with high Z-score while the effects on the accrual earnings management to be more pronounced in the firms with low Z-score.

The results from this analysis are reported in Table 5. Consistent with our expectation, real earnings management significantly drops for the pilot firms compared to the non-pilot firms in the subsample with good financial health as indicated by higher Z-score (Columns 1 and 3). However, such effect is not significant in the subsample with lower Z-score (Columns 2 and 4). On the contrary, the accrual earnings management for the pilot firms significantly decreases compared to non-pilot firms in the subsample with lower Z-score (Column 6), while the effect is not statistically significant in higher Z-score (Columns 5 and 7). Overall, this evidence supports our view that the effects of Regulation SHO on real (accrual) earnings management is stronger in subsamples with good (poor) financial health.

3.2.2 Short selling and analyst coverage

Previous literature shows that security analyst also plays a role in constraining managers' engagement in the earnings management. Irni and Oesch (2016) reveal the substitution relation between accrual and real earnings management by showing that under the monitoring pressure from securities analysts, managers tend to use less accrual-based tools but more real activity manipulations to meet the earnings targets. There is a shift from accrual-based management to

real activity manipulation when firms face more severe monitoring from the analysts, suggesting that the monitoring function of securities analysts is effective in reducing accrual earnings management but limited in constraining real earnings management. However, our results so far indicate that short sellers could constrain both accrual and real earnings management simultaneously. In this subsection, we attempt to examine whether short selling threat is a more effective mechanism than securities analysts monitoring in constraining real earnings management.

We split our sample into two groups based on the analyst coverage in 2003 (i.e. one year before the announcement of pilot program). Specifically, we define an indicator variable that is equal to one if the number of analyst coverage of a firm is greater than the industry median, and zero otherwise. Based on Irni and Oesch (2016), the firms under the pressure from the higher-level analyst coverage would engage in more real activity manipulation as a natural alternative to meet the earnings target. Therefore, the firms with more analyst coverage would rely more on real earnings management while the firms with less analyst coverage would rely more on the accrual earnings management prior to the removal of the short-selling constraints. If short sellers are more effective at constraining real earnings management than analysts, we expect that the effect of the pilot program on real earnings management would be more pronounced in those firms with higher analyst coverage. For the accrual earnings management, we expect short seller disciplining effect would be more pronounced in the subsample with lower analyst coverage.

Table 6 shows the results for subsample analysis based on analyst coverage. For the effects on the real earnings management, when we use $RM1$ as the aggregate measure for real activity manipulation in Columns 1 and 2, the coefficients on the interaction terms ($Pilot_i \times During_t$) are both statistically significant in the subsample with high or low analyst coverage. However, in terms of economic magnitude, the effect in the high analyst coverage subsample (i.e. -0.020) almost doubles the effect in the low analyst coverage subsample (i.e. -0.012). When we use

$RM2$ as the real earnings management measure (Columns 3 and 4), the effect is only statistically significant in the subsample with high analyst coverage. Columns 5 to 8 shows the results for the effect on accrual earnings management. Consistent with our expectation, the short seller discipling effect is more pronounced in the subsample with low analyst coverage. Overall, the results from Table 6 suggest that effects of Regulation SHO on real (accrual) earnings management is stronger in subsamples with high (low) analyst coverage. This provides the evidence to support our view that as corporate external monitors, the monitoring function of short sellers are more effective than securities analysts in terms of constraining real earnings management.

3.2.3. Short selling and internal governance strength

Previous literatures have shown that internal corporate governance could influence earnings management. For example, Carcello, Hollingsworth, Klein, and Neal (2006) find that independent audit committee on the board are effective in mitigating firms' engagement in earnings management. Cheng, Lee, and Shevlin (2016) investigate the internal governance role of the key subordinate executives in the firm and document that these executives have both incentives and ability to monitor CEO decisions and could mitigate CEO's engagement in real earnings management. We argue that the external monitoring role played by short sellers on disciplining earnings management would be more important in the firms with poor internal corporate governance.

In the following test, we use G-index to measure the strength of internal governance. Following Gompers, Ishii, and Metrick (2003), G-index captures the level of shareholder rights. The higher G-index is associated with weaker shareholder rights and greater managerial entrenchment, which implies poor corporate governance. We split our sample into two groups based on G-index measured in 2003 (i.e. one year before the announcement of pilot program). Specifically, we define an indicator variable that is equal to one if the G-index of a firm is

greater than the industry median, and zero otherwise. Table 7 displays the results of subsample analysis conditional on G-index. In Columns 1 and 2, we measure real earnings management by $RM1$. We find that pilot firms exhibit 0.030 lower real earnings management than non-pilot firms during the pilot program in the subsample with high G-index (i.e. poor internal governance). The effect is statistically significant at 1% level. However, the effect of short selling on real earnings management is not significant in the firms with low G-index. In Columns 3 and 4, the dependent variable is $RM2$. Similarly, we find that effect of short selling is more pronounced in the firms with higher G-index, while there is no significant effect on firms with lower G-index. Overall, the results for the real earnings management are consistent with our prediction that the disciplining effects of short selling are stronger when shareholders' rights are weaker, and managers are more entrenched. However, we did not find similar evidence in the accrual earnings management. As shown in Table 7 Columns 5 to 8, there is no significant effect on the accrual earnings management in this subsample analysis.

4 The Effects of Regulation SHO's pilot Program on short interest

In this section, we re-examine the effect of Regulation SHO on short sales activity to provide additional insights into the important role that short sellers play in monitoring firms' engagement in the earnings management. We firstly test whether the short interest, as the proxy for the short sales activity increases after the announcement of Regulation SHO's pilot program following Grullon, Michenaud, and Weston (2015). Then, we carry out the subsample analysis to test whether short sellers would target the firms with high level earnings management and increase the short interest on these firms.

We follow the methodology in Grullon, Michenaud, and Weston (2015) and focus on event window around the announcement date of the pilot program. As explained in their paper, the reason to focus on the announcement date instead of the actual implementation date is that investors would incorporate the future impact of the regulation change at the time of the announcement, even before the actual suspension of the price test. Therefore, short sellers who

anticipate the real effect of the removal of short selling constrain would target those pilot firms immediately after the announcement. In the following test, our sample period starts from one year before the announcement of pilot program (i.e. July 28, 2004) and ends at nine months after the announcement date. We adopt the DiD specification as Equation (7) to examine the difference of the short interest between pilot and non-pilot firms from before to after the announcement.

$$SI_{i,t} = \alpha + \beta_1 \times Pilot_i + \beta_2 \times Pilot_i \times During_t + \delta X + Year\ FE + \varepsilon_{i,t} \quad (7)$$

We use both *Short interest* and *Abnormal monthly short interest* as our dependent variable ($SI_{i,t}$). The monthly short interest data is obtained from Compustat Security Short Interest database. Short interest reflects open short positions of stocks with settlements on the 15th of each month or the preceding business day if the 15th is not a business day[7]. Dependent variable, *Short interest*, is calculated by using raw short interest number divided by the CRSP number of shares outstanding on the same date and multiply the ratio by 100. Following Grullon, Michenaud, and Weston (2015), *Abnormal monthly short interest* is the residual of a firm fixed effect regression where *Short interest* is regressed with firm fixed effects, controlling for month dummies, market-to-book, logarithm of lagged total assets, lagged return on assets, trading volume, and a dummy variable for listing on the NYSE. For the independent variables, $Pilot_i$ is the firm indicator variable for the pilot firms. $During_t$ is the time indicator variable for the period after the announcement date but before the implementation date. Other control variables are the same as the ones used in previous test.

Table 8 reports the OLS regression results on differences in pilot and non-pilot firms' *Short Interest* and *Abnormal Short interest* for one year before the pilot program announcement date (July 28, 2004) and for nine months after the announcement. Columns 1 and 6 report the results for the full sample. Both short interest and abnormal short interest increase more in the pilot

[7] In addition, they are also required to report their positions as of settlement on the last business day of the month from 2007. Following Park (2017), we use only short interest that is reported as of settlement on the 15th of each month or on the preceding business day if the 15th is not a business day throughout the entire sample period to maintain consistency.

firms compared to the non-pilot firms after the announcement. The coefficient on the interaction term ($Pilot_i \times During_t$) are statistically significant at 1% level, which is consistent with the results in Grullon, Michenaud, and Weston (2015). Next, we carry out the subsample analysis based on the prior earnings management status. Specifically, we define the firms with higher real earnings management if one of the three real earnings management measures (i.e. RM_PROD, RM_CFO, RM_DISX) is greater than industry median in the year before the announcement date. Similarly, we define the firms with higher accrual earnings management if the accrual earnings management measure (i.e. AM) is greater than industry median in the year before the announcement date. Columns 2 to 5 shows the subsample analysis for the *Short Interest.* We find that the effects of pilot program on short interest is more pronounced in the firms with higher real earnings management or higher accrual earnings management as indicated by the significant coefficient on the interaction term ($Pilot_i \times During_t$) in Columns 2 and 4, while the subsample with low real earnings management or low accrual earnings management do not have significant effects. The results are similar when we use the *Abnormal Short interest* as dependent variable from Columns 6 to 8. Overall, this provides us additional evidence to support the view that short sellers do target the firms with high level earnings manipulation, and this is also consistent with our previous results for short seller disciplining effects on both accrual and earnings management during the pilot program.

5 Conclusion

In this paper, we examine the effect of short selling on both accrual-based and real earnings management by exploiting a quasi-natural experiment, Regulation SHO. First, we test how the removal of short sale price tests affects accrual-based and real earnings management simultaneously and find that the short selling threat substantially reduces both types of earnings manipulation in pilot firms relative to non-pilot firms, which is consistent with short seller disciplining effects on managers behavior. Second, our cross-sectional analysis shows that such disciplining effects are stronger on one type of earnings management approaches when the cost

associated with the other type is high. Specifically, the short selling disciplining effects on real earnings management are more pronounced in the firms audited by big 4, firms with low institutional ownership, and firms in good financial health condition. Third, we find that the discipling effects on real earnings management is stronger in the subsample with higher level of analyst coverage. Given that managers would shift from accrual to real earnings management under analyst monitoring pressure documented in Irani and Oes (2016), our results suggest that short selling threat is more effective than security analyst in that it leads to a total reduction in both accrual and real earnings management. Finally, we find that short sellers do target the firms with high level real or accrual earnings management by increasing the short interests on these firms after the announcement of the Regulation SHO's pilot program. Overall, our findings provide a complete picture for the effect of short sellers on earnings management.

Table 1
Summary Statistics for the Analysis of Real Earning Management

This table reports the summary statistics for the analysis of the real earning management. Panel A shows the summary statistics of the full sample from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive). Panel B compares the firm characteristics between pilot firms and non-pilot firms in the fiscal year 2003, the year immediately before Regulation SHO's pilot program was announced. RM_CFO is the abnormal cash flow from operation. RM_PROD is the abnormal production cost. RM_DISX is the abnormal discretionary expenses. The details of their definition are provided in the Appendix. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization.

Panel A

	Observation	Mean	Standard deviation	Q1	Median	Q3
RM_CFO	13,927	-0.014	0.119	-0.074	-0.020	0.034
RM_PROD	13,927	-0.057	0.235	-0.154	-0.053	0.043
RM_DISX	13,927	-0.077	0.250	-0.175	-0.035	0.050
RM1	13,927	-0.133	0.421	-0.320	-0.100	0.071
RM2	13,927	-0.091	0.260	-0.213	-0.069	0.042
AM	13,927	-0.012	0.107	-0.046	-0.006	0.032
Control variables						
Firm size	13,926	6.926	1.628	5.844	6.791	7.899
ROA	13,921	0.014	0.266	-0.011	0.046	0.095
MTB	13,421	0.853	0.788	0.369	0.797	1.275

Panel B

	Treated Firms				Control Firms					
	Observation	Mean	Median	Standard deviation	Observation	Mean	Median	Standard deviation	Difference	t-statistic
Firm size	591	6.990	6.739	1.444	1,209	6.908	6.628	1.402	0.083	1.164
ROA	583	0.031	0.048	0.150	1,190	0.013	0.037	0.258	0.018	1.596
MTB	580	1.053	0.911	0.761	1,175	1.054	0.979	0.750	-0.001	-0.015

Table 2
The Effect of Pilot Program on Earnings Management

This table reports the OLS regression results on differences in pilot and non-pilot firms' real earnings management and accrual earnings management for the periods before, during, and after Regulation SHO's pilot program. The sample period spans from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive). RM1 and RM2 are two aggregate measures of real earnings management. $RM1 = RM\_PROD + RM\_DISX$ and $RM2 = RM\_CFO + RM\_DISX$ where RM_PROD is abnormal production costs, RM_DISX is abnormal discretionary expense and RM_CFO is abnormal sale. AM is the measure of accrual earnings management. The details of the definitions are provided in the Appendix. $Pilot$ equals one if the firm is pilot firm and zero otherwise. $During$ is the indicator variable for treatment period which equals one if fiscal year end falls between January 1st 2005 and December 31st 2007 and zero otherwise. $Post$ is the indicator variable for the period after the end of pilot program which equals one if fiscal year end falls between January 1st 2008 and December 31st 2010 and zero otherwise. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization. We also year fixed effect in each column. For brevity, the coefficients on the fixed effects are omitted. Standard errors are clustered by year and firm (two-way clustering). P-values are displayed in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels using two-tailed tests.

	Dependant variable					
	RM1	RM2	RM_PROD	RM_CFO	RM_DISX	AM
	(1)	(2)	(3)	(4)	(5)	(6)
Pilot	0.002	0.006	-0.007	-0.004	0.012	0.004**
	(0.892)	(0.574)	(0.418)	(0.139)	(0.184)	(0.036)
Pilot x During	-0.018***	-0.011***	-0.006**	-0.001	-0.011***	-0.007*
	(0.001)	(0.000)	(0.036)	(0.614)	(0.000)	(0.078)
Pilot x Post	-0.017**	-0.004	-0.004	0.003*	-0.008**	-0.001
	(0.030)	(0.299)	(0.378)	(0.088)	(0.026)	(0.708)
Firm size	0.014**	0.017***	-0.002	-0.004***	0.021***	-0.002
	(0.044)	(0.001)	(0.537)	(0.007)	(0.000)	(0.128)
ROA	0.411***	0.038	-0.115***	-0.418***	0.468***	0.079***
	(0.000)	(0.376)	(0.005)	(0.000)	(0.000)	(0.009)
MTB	-0.166***	-0.100***	-0.068***	-0.005**	-0.096***	0.000
	(0.000)	(0.000)	(0.000)	(0.032)	(0.000)	(0.942)
Constant	-0.125**	-0.128***	0.037	0.058***	-0.187***	-0.009
	(0.012)	(0.000)	(0.164)	(0.000)	(0.000)	(0.232)
Observations	13,415	13,415	13,415	13,415	13,415	13,415
R-squared	0.108	0.087	0.084	0.376	0.182	0.018
Year FE	YES	YES	YES	YES	YES	YES
Cluster	firm year	firm year	firm year	firm year	firm year	firm year

Table 3
Subsample Analysis: Conditional on Big4 auditor

This table reports the subsample analysis for the effect of pilot program on real earnings management and accrual earnings management. The sample period spans from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive). We split the sample based on whether the firm is audited by Big 4. RM1 and RM2 are two aggregate measures of real earnings management. $RM1 = RM\_PROD + RM\_DISX$ and $RM2 = RM\_CFO + RM\_DISX$ where RM_PROD is abnormal production costs, RM_DISX is abnormal discretionary expense and RM_CFO is abnormal sale. AM is the measure of accrual earnings management. The details of the definitions are provided in the Appendix. $Pilot$ equals one if the firm is pilot firm and zero otherwise. $During$ is the indicator variable for treatment period which equals one if fiscal year end falls between January 1st 2005 and December 31st 2007 and zero otherwise. $Post$ is the indicator variable for the period after the end of pilot program which equals one if fiscal year end falls between January 1st 2008 and December 31st 2010 and zero otherwise. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization. We also include year fixed effect in each column. For brevity, the coefficients on the fixed effects are omitted. Standard errors are clustered by year and firm (two-way clustering). P-values are displayed in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels using two-tailed tests.

	Dependant variable							
	RM1	RM1	RM2	RM2	AM	AM	AM	AM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pilot	0.008	-0.037	0.010	-0.032	0.003	0.021**	0.002	0.023**
	(0.624)	(0.297)	(0.312)	(0.215)	(0.162)	(0.015)	(0.303)	(0.013)
Pilot x During	-0.020***	0.004	-0.009**	-0.015	-0.005	-0.028**	-0.004	-0.025*
	(0.002)	(0.933)	(0.026)	(0.667)	(0.390)	(0.040)	(0.431)	(0.066)
Pilot x Post	-0.016*	-0.019	-0.006	0.006	0.003	-0.033**	0.003	-0.033**
	(0.081)	(0.737)	(0.300)	(0.852)	(0.386)	(0.034)	(0.397)	(0.032)
Firm size	0.017**	0.022	0.021***	0.002	-0.001	-0.013***	-0.002	-0.011**
	(0.040)	(0.355)	(0.001)	(0.905)	(0.555)	(0.004)	(0.139)	(0.023)
ROA	0.382***	0.315**	-0.011	0.014	0.080**	0.118*	0.087**	0.125*
	(0.000)	(0.012)	(0.789)	(0.854)	(0.030)	(0.070)	(0.017)	(0.072)
MTB	-0.172***	-0.185***	-0.105***	-0.096***	0.002	0.022***	0.006**	0.025***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.475)	(0.003)	(0.042)	(0.002)
AM	0.392***	0.379***	0.515***	0.410***				
	(0.000)	(0.004)	(0.000)	(0.004)				
RM1					0.024***	0.046**		
					(0.000)	(0.013)		
RM2							0.080***	0.134**
							(0.000)	(0.022)
Constant	-0.136**	-0.125	-0.145***	-0.015	-0.015	0.056**	-0.006	0.050*
	(0.015)	(0.319)	(0.000)	(0.870)	(0.114)	(0.015)	(0.505)	(0.055)
Observations	12,107	1,302	12,107	1,302	12,107	1,302	12,107	1,302
R-squared	0.111	0.143	0.126	0.137	0.027	0.057	0.058	0.093
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	firm year	firm year	firm year	firm year	firm year	firm year	firm year	firm year
Big4	Yes	No	Yes	No	Yes	No	Yes	No

Table 4
Subsample Analysis: Conditional on Institutional Ownership

This table reports the subsample analysis for the effect of pilot program on real earnings management and accrual earnings management. The sample period spans from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive). We split the sample based on firms' institutional ownership. The firms with high-level (low-level) institutional ownership are those with institutional holdings greater (lower) than industry median. RM1 and RM2 are two aggregate measures of real earnings management. $RM1 = RM\_PROD + RM\_DISX$ and $RM2 = RM\_CFO + RM\_DISX$ where RM_PROD is abnormal production costs, RM_DISX is abnormal discretionary expense and RM_CFO is abnormal sale. AM is the measure of accrual earnings management. The details of the definitions are provided in the Appendix. $Pilot$ equals one if the firm is pilot firm and zero otherwise. $During$ is the indicator variable for treatment period which equals one if fiscal year end falls between January 1st 2005 and December 31st 2007 and zero otherwise. $Post$ is the indicator variable for the period after the end of pilot program which equals one if fiscal year end falls between January 1st 2008 and December 31st 2010 and zero otherwise. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization. We also include year fixed effect in each column. For brevity, the coefficients on the fixed effects are omitted. Standard errors are clustered by year and firm (two-way clustering). P-values are displayed in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels using two-tailed tests.

	Dependant variable							
	RM1	RM1	RM2	RM2	AM	AM	AM	AM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pilot	0.002	-0.002	0.006	0.000	0.008**	0.001	0.007**	0.001
	(0.907)	(0.943)	(0.682)	(0.973)	(0.021)	(0.614)	(0.027)	(0.649)
Pilot x During	-0.003	-0.022***	0.002	-0.013***	-0.007***	-0.005	-0.007***	-0.005
	(0.527)	(0.003)	(0.551)	(0.005)	(0.002)	(0.295)	(0.002)	(0.348)
Pilot x Post	-0.009	-0.019**	0.002	-0.006	-0.007	0.004	-0.007	0.004
	(0.353)	(0.038)	(0.766)	(0.324)	(0.202)	(0.133)	(0.185)	(0.149)
Firm size	0.013	0.011	0.008	0.022***	0.001	-0.003**	0.001	-0.005***
	(0.166)	(0.183)	(0.197)	(0.001)	(0.402)	(0.030)	(0.571)	(0.006)
ROA	0.206	0.398***	-0.071	-0.006	0.068***	0.079**	0.077***	0.085**
	(0.163)	(0.000)	(0.404)	(0.890)	(0.002)	(0.019)	(0.001)	(0.011)
MTB	-0.154***	-0.164***	-0.091***	-0.102***	0.000	0.006**	0.004	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.894)	(0.049)	(0.264)	(0.007)
AM	0.735***	0.404***	0.819***	0.553***				
	(0.000)	(0.002)	(0.000)	(0.000)				
RM1					0.034***	0.021***		
					(0.000)	(0.000)		
RM2							0.094***	0.074***
							(0.000)	(0.000)
Constant	-0.070	-0.116**	-0.040	-0.151***	-0.027**	0.003	-0.024*	0.011
	(0.313)	(0.038)	(0.355)	(0.001)	(0.032)	(0.745)	(0.054)	(0.176)
Observations	5,098	8,299	5,098	8,299	5,098	8,299	5,098	8,299
R-squared	0.113	0.119	0.161	0.124	0.040	0.034	0.091	0.066
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	firm year	firm year	firm year	firm year	firm year	firm year	firm year	firm year
Institution Ownership	High	Low	High	Low	High	Low	High	Low

Table 5
Subsample Analysis: Conditional on financial health

This table reports the subsample analysis for the effect of pilot program on real earnings management and accrual earnings management. The sample period spans from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive). We split the sample based on firms' financial health. Following Zang (2012), z-score measure is used to proxy for a firm's financial health. The firms with high-level (low-level) financial health are those with z-score measure greater (lower) than industry median. RM1 and RM2 are two aggregate measures of real earnings management. $RM1 = RM\_PROD + RM\_DISX$ and $RM2 = RM\_CFO + RM\_DISX$ where RM_PROD is abnormal production costs, RM_DISX is abnormal discretionary expense and RM_CFO is abnormal sale. AM is the measure of accrual earnings management. The details of the definitions are provided in the Appendix. $Pilot$ equals one if the firm is pilot firm and zero otherwise. $During$ is the indicator variable for treatment period which equals one if fiscal year end falls between January 1st 2005 and December 31st 2007 and zero otherwise. $Post$ is the indicator variable for the period after the end of pilot program which equals one if fiscal year end falls between January 1st 2008 and December 31st 2010 and zero otherwise. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization. We also include year fixed effect in each column. For brevity, the coefficients on the fixed effects are omitted. Standard errors are clustered by year and firm (two-way clustering). P-values are displayed in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels using two-tailed tests.

	Dependant variable							
	RM1	RM1	RM2	RM2	AM	AM	AM	AM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pilot	0.006	-0.003	0.004	0.002	0.003	0.006	0.003	0.005
	(0.810)	(0.874)	(0.809)	(0.834)	(0.436)	(0.183)	(0.476)	(0.221)
Pilot x During	-0.031***	0.002	-0.011**	-0.003	-0.005	-0.008*	-0.004	-0.008
	(0.000)	(0.775)	(0.010)	(0.488)	(0.399)	(0.089)	(0.415)	(0.116)
Pilot x Post	-0.052***	0.020	-0.020***	0.014	0.003	-0.004	0.003	-0.004
	(0.000)	(0.158)	(0.000)	(0.139)	(0.503)	(0.371)	(0.486)	(0.314)
Firm size	0.003	0.023***	0.018**	0.016***	-0.005***	0.001	-0.006***	0.000
	(0.743)	(0.008)	(0.013)	(0.004)	(0.002)	(0.452)	(0.000)	(0.899)
ROA	0.433***	0.390***	0.013	0.012	0.059***	0.100**	0.065***	0.104**
	(0.000)	(0.000)	(0.788)	(0.787)	(0.009)	(0.041)	(0.004)	(0.033)
MTB	-0.189***	-0.136***	-0.115***	-0.081***	0.007*	0.002	0.011***	0.005*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.058)	(0.435)	(0.007)	(0.053)
AM	0.567***	0.392***	0.705***	0.538***				
	(0.000)	(0.000)	(0.000)	(0.000)				
RM1					0.025***	0.024***		
					(0.000)	(0.000)		
RM2							0.078***	0.083***
							(0.000)	(0.000)
Constant	-0.053	-0.173***	-0.124***	-0.110***	0.015*	-0.029***	0.023**	-0.023**
	(0.387)	(0.004)	(0.007)	(0.003)	(0.078)	(0.010)	(0.010)	(0.033)
Observations	6,765	6,632	6,765	6,632	6,765	6,632	6,765	6,632
R-squared	0.125	0.116	0.136	0.124	0.032	0.043	0.073	0.077
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	firm year	firm year	firm year	firm year	firm year	firm year	firm year	firm year
z-score	High	Low	High	Low	High	Low	High	Low

Table 6
Subsample Analysis: Conditional on Analyst Coverage

This table reports the subsample analysis for the effect of pilot program on real earnings management and accrual earnings management. The sample period spans from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive). We split the sample based on analyst coverage. The firms with high-level (low-level) analyst coverage are those with analyst coverage greater (lower) than industry median. RM1 and RM2 are two aggregate measures of real earnings management. $RM1 = RM\_PROD + RM\_DISX$ and $RM2 = RM\_CFO + RM\_DISX$ where RM_PROD is abnormal production costs, RM_DISX is abnormal discretionary expense and RM_CFO is abnormal sale. AM is the measure of accrual earnings management. The details of the definitions are provided in the Appendix. $Pilot$ equals one if the firm is pilot firm and zero otherwise. $During$ is the indicator variable for treatment period which equals one if fiscal year end falls between January 1st 2005 and December 31st 2007 and zero otherwise. $Post$ is the indicator variable for the period after the end of pilot program which equals one if fiscal year end falls between January 1st 2008 and December 31st 2010 and zero otherwise. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization. We also include year fixed effect in each column. For brevity, the coefficients on the fixed effects are omitted. Standard errors are clustered by year and firm (two-way clustering). P-values are displayed in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels using two-tailed tests.

	Dependant variable							
	RM1	RM1	RM2	RM2	AM	AM	AM	AM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pilot	-0.013	0.014	0.000	0.006	0.005	0.004	0.004	0.004
	(0.516)	(0.537)	(0.994)	(0.674)	(0.112)	(0.300)	(0.156)	(0.324)
Pilot x During	-0.020**	-0.012*	-0.011***	-0.003	-0.002	-0.011*	-0.002	-0.011*
	(0.011)	(0.088)	(0.005)	(0.451)	(0.589)	(0.076)	(0.689)	(0.065)
Pilot x Post	-0.010	-0.028***	0.002	-0.012***	0.002	-0.004	0.002	-0.003
	(0.444)	(0.001)	(0.764)	(0.008)	(0.496)	(0.406)	(0.630)	(0.454)
Firm size	0.028***	0.024**	0.035***	0.007	0.002	-0.005**	-0.000	-0.005*
	(0.006)	(0.031)	(0.000)	(0.233)	(0.138)	(0.041)	(0.730)	(0.050)
ROA	0.211**	0.470***	-0.174**	0.117**	0.074**	0.079**	0.091***	0.077**
	(0.038)	(0.000)	(0.013)	(0.012)	(0.015)	(0.016)	(0.004)	(0.017)
MTB	-0.172***	-0.153***	-0.105***	-0.088***	0.001	0.008**	0.005	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.690)	(0.018)	(0.119)	(0.004)
AM	0.623***	0.324***	0.732***	0.469***				
	(0.000)	(0.009)	(0.000)	(0.000)				
RM1					0.027***	0.019***		
					(0.000)	(0.002)		
RM2							0.081***	0.072***
							(0.000)	(0.000)
Constant	-0.215***	-0.169**	-0.244***	-0.054	-0.037***	0.014	-0.022**	0.014
	(0.004)	(0.015)	(0.000)	(0.162)	(0.002)	(0.275)	(0.033)	(0.274)
Observations	7,412	5,985	7,412	5,985	7,412	5,985	7,412	5,985
R-squared	0.117	0.128	0.167	0.112	0.040	0.032	0.081	0.059
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	firm year	firm year	firm year	firm year	firm year	firm year	firm year	firm year
Analyst Coverage	High	Low	High	Low	High	Low	High	Low

Table 7
Subsample Analysis: Conditional on G-index

This table reports the subsample analysis for the effect of pilot program on real earnings management and accrual earnings management. The sample period spans from 2001 to 2003 (inclusive) and 2005 to 2010 (inclusive). We split the sample based on G-index. The firms with high-level (low-level) G-index are those with G-index greater (lower) than industry median. RM1 and RM2 are two aggregate measures of real earnings management. $RM1 = RM\_PROD + RM\_DISX$ and $RM2 = RM\_CFO + RM\_DISX$ where RM_PROD is abnormal production costs, RM_DISX is abnormal discretionary expense and RM_CFO is abnormal sale. AM is the measure of accrual earnings management. The details of the definitions are provided in the Appendix. $Pilot$ equals one if the firm is pilot firm and zero otherwise. $During$ is the indicator variable for treatment period which equals one if fiscal year end falls between January 1st 2005 and December 31st 2007 and zero otherwise. $Post$ is the indicator variable for the period after the end of pilot program which equals one if fiscal year end falls between January 1st 2008 and December 31st 2010 and zero otherwise. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization. We also include year fixed effect in each column. For brevity, the coefficients on the fixed effects are omitted. Standard errors are clustered by year and firm (two-way clustering). P-values are displayed in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels using two-tailed tests.

	Dependant variable							
	RM1	RM1	RM2	RM2	AM	AM	AM	AM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pilot	0.012	-0.000	0.015	0.001	0.005	0.002	0.004	0.002
	(0.619)	(0.983)	(0.320)	(0.950)	(0.141)	(0.517)	(0.241)	(0.539)
Pilot x During	-0.030***	-0.009	-0.014***	-0.006	-0.005	-0.007	-0.004	-0.006
	(0.000)	(0.208)	(0.001)	(0.226)	(0.403)	(0.244)	(0.440)	(0.271)
Pilot x Post	-0.049***	0.005	-0.025***	0.010	0.000	-0.001	0.001	-0.002
	(0.000)	(0.734)	(0.000)	(0.336)	(0.955)	(0.766)	(0.784)	(0.676)
Firm size	0.005	0.020**	0.011*	0.023***	0.002	-0.005***	0.001	-0.007***
	(0.640)	(0.048)	(0.067)	(0.003)	(0.119)	(0.008)	(0.354)	(0.002)
ROA	0.046	0.413***	-0.187*	0.008	0.134***	0.092**	0.144***	0.099**
	(0.734)	(0.000)	(0.055)	(0.848)	(0.002)	(0.026)	(0.001)	(0.017)
MTB	-0.131***	-0.185***	-0.084***	-0.109***	-0.006***	0.009**	-0.003	0.013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.025)	(0.147)	(0.003)
AM	0.546***	0.343***	0.639***	0.459***				
	(0.000)	(0.001)	(0.000)	(0.000)				
RM1					0.025***	0.027***		
					(0.000)	(0.001)		
RM2							0.079***	0.090***
							(0.000)	(0.000)
Constant	-0.019	-0.153**	-0.052	-0.154***	-0.035***	0.012	-0.031***	0.022*
	(0.801)	(0.016)	(0.228)	(0.001)	(0.001)	(0.262)	(0.003)	(0.065)
Observations	5,459	7,938	5,459	7,938	5,459	7,938	5,459	7,938
R-squared	0.073	0.137	0.124	0.130	0.039	0.032	0.075	0.064
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	firm year	firm year	firm year	firm year	firm year	firm year	firm year	firm year
G-index	High	Low	High	Low	High	Low	High	Low

Table 8
Regulation SHO and Short interest conditional on earnings management

This table reports the OLS regression results on differences in pilot and non-pilot firms' short interest and abnormal short interest for one year before the announcement date (July 28, 2004) and for nine months after the announcement (but before the implementation date). For the dependant variables, *Short interest* is calculated by using raw short interest number divided by the CRSP number of shares outstanding on the same date and multiply the ratio by 100. *Abnormal monthly short interest* is the residual of a firm fixed effect regression where *Short interest* is regressed with firm fixed effects, controlling for month dummies, market-to-book, logarithm of lagged total assets, lagged return on assets, trading volume, and a dummy variable for listing on the NYSE. For the independent variables, $Pilot$ equals one if the firm is pilot firm and zero otherwise. $During$ is the indicator variable for period which equals one for the period after the announcement date but before the implementation date and zero otherwise. For control variables, $firm\ size$ is measured as the natural logarithm of a firm's market capitalization which is calculated as the number of shares outstanding times price. ROA is measured as a firm's net income divided by its total assets. MTB is measured as the natural logarithm of a firm's book value divided by its market capitalization. We also include year fixed effect in each column. For brevity, the coefficients on the fixed effects are omitted. For the subsample analysis indicators, *High REM* is a dummy variable that equals one if one of the three real earnings management measures (i.e. RM_PROD, RM_CFO, RM_DISX) is greater than industry median in the year before the announcement date, and zero otherwise. *High AEM* is the dummy variable that equals one if the accrual earnings management measure (AM) is greater than industry median in the year before the announcement date, and zero otherwise. Standard errors are clustered by firm. P-values are displayed in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels using two-tailed tests.

	Dependant variable									
	Short interest					Abnormal short interest				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Pilot	-0.304	-0.167	-0.616	-0.250	-0.422	-0.278**	-0.151	-0.442*	-0.143	-0.296
	(0.124)	(0.487)	(0.174)	(0.424)	(0.140)	(0.022)	(0.322)	(0.093)	(0.453)	(0.101)
Pilot x During	0.301***	0.325**	0.107	0.291*	0.253	0.293***	0.324***	0.106	0.294**	0.220
	(0.005)	(0.018)	(0.623)	(0.074)	(0.128)	(0.002)	(0.009)	(0.598)	(0.045)	(0.140)
Firm size	-0.305***	-0.209***	-0.799***	-0.319***	-0.397***	0.250***	0.272***	0.113	0.240***	0.226***
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.152)	(0.000)	(0.000)
MTB	0.078***	0.105***	0.077	0.026	0.170***	-0.005	0.010	-0.004	-0.013	0.031
	(0.001)	(0.001)	(0.182)	(0.479)	(0.000)	(0.687)	(0.558)	(0.891)	(0.556)	(0.152)
ROA	-5.212*	-9.357**	15.015	-3.521	-4.425	-2.320	-4.918**	5.093	-3.036	-2.928
	(0.084)	(0.038)	(0.103)	(0.494)	(0.470)	(0.155)	(0.040)	(0.256)	(0.270)	(0.356)
Constant	10.838***	8.737***	20.750***	11.182***	12.445***	-5.575***	-6.036***	-2.796*	-5.281***	-5.174***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.086)	(0.000)	(0.000)
Observations	42,501	26,705	7,877	17,322	17,607	42,501	26,705	7,877	17,322	17,607
R-squared	0.019	0.022	0.055	0.016	0.034	0.014	0.019	0.013	0.015	0.014
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster	firm	firm	firm	firm	firm	firm	firm	firm	firm	firm
Subsample indicator	Full sample	High REM	Low REM	High AEM	Low AEM	Full sample	High REM	Low REM	High AEM	Low AEM

Appendix: Definition of main variables

Variable	Definition
AM	Accrual earnings management is defined as the difference between its total accruals and the fitted normal accruals derived from a modified Jones model (Jones 1991). The modified Jones model follows Dechow, Sloan, Sweeney (1995) and is specified as $\frac{TA_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{\Delta REV_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{PPE_{i,t}}{Asset_{i,t-1}} + \varepsilon_{i,t}$ for each Fama-French 48 industry and year combination. The fitted value is estimated by: $\frac{NA_{i,t}}{Asset_{i,t-1}} = \hat{\beta}_1 \frac{1}{Asset_{i,t-1}} + \hat{\beta}_2 \frac{\Delta REV_{i,t} - \Delta AR_{i,t}}{Asset_{i,t-1}} + \hat{\beta}_3 \frac{PPE_{i,t}}{Asset_{i,t-1}}$. $AM_{i,t}$ is defined as the difference between $\frac{TA_{i,t}}{Asset_{i,t-1}}$ and $\frac{NA_{i,t}}{Asset_{i,t-1}}$.
RM_PROD	Abnormal production costs which is measured as the residual from the OLS regression: $\frac{PROD_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{SALES_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{\Delta SALES_{i,t}}{Asset_{i,t-1}} + \beta_4 \frac{\Delta SALES_{i,t-1}}{Asset_{i,t-1}} + \varepsilon_{i,t}$ for each Fama French 48 industry and year combination.
RM_CFO	Abnormal cash flow from operation, which is measured as the negative one multiplied by the residual from the OLS regression: $\frac{CFO_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{SALES_{i,t}}{Asset_{i,t-1}} + \beta_3 \frac{\Delta SALES_{i,t}}{Asset_{i,t-1}} + \varepsilon_{i,t}$ for each Fama French 48 industry and year combination.
RM_DISX	Abnormal discretionary expenses, which is measured as negative one multiplied by the residual from the OLS regression: $\frac{DISX_{i,t}}{Asset_{i,t-1}} = \beta_1 \frac{1}{Asset_{i,t-1}} + \beta_2 \frac{SALES_{i,t-1}}{Asset_{i,t-1}} + \varepsilon_{i,t}$ for each Fama French 48 industry and year combination.
RM1	Aggregate real earnings management measure for abnormal production costs and abnormal cash flow from operation: $RM1 = RM\_PROD + RM\_DISX$.
RM2	Aggregate real earnings management measure for abnormal cash flow from operation and abnormal discretionary expenses: $RM2 = RM\_CFO + RM\_DISX$.
Pilot	Indicator variable for pilot firms which equals one if the firm is pilot firm and zero otherwise.
During	Indicator variable for treatment period which equals one if fiscal year end falls between January 1st, 2005 and December 31st 2007 and zero otherwise.
Post	Indicator variable for the period after the end of pilot program which equals one if fiscal year end falls between January 1st, 2008 and December 31st , 2010 and zero otherwise.
Firm size	Natural logarithm of market capitalization ($csho \times prcc\_f$).
ROA	Net income divided by total assets ($oibdp/at$).
MTB	Natural logarithm of a firm's book value divided by its market capitalization ($prcc_f \times csho/ceq$).
z-score	Firms' financial health is measured by Altman's Z-score (Altman 1968, 2000): $ZSCORE_t = 0.3 \frac{NI_t}{Asset_t} + 1.0 \frac{Sales_t}{Asset_t} + 1.4 \frac{Retained\ Earnings_t}{Asset_t} + 1.2 \frac{Working\ Capital_t}{Asset_t} + 0.6 \frac{Stock\ Price \times Share\ Outstanding_t}{Total\ Liabilities_t}$.
Short interest	Raw short interest number divided by the CRSP number of shares outstanding on the same date and multiply the ratio by 100.
Abnormal short interest	Abnormal short interest is estimated as the residual of a firm fixed effect regression where *Short interest* is regressed with firm fixed effects, controlling for month dummies, market-to-book, logarithm of lagged total assets, lagged return on assets, trading volume, and a dummy variable for listing on the NYSE.

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