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Is Real Earnings Smoothing Harmful? Evidence from Firm-Specific Stock Price Crash Risk*

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ABSTRACT

This study examines whether and when real earnings smoothing influences firm-specific stock price crash risk. Using a sample of U.S. public firms for the years 1993 through 2014, we find real earnings smoothing to be positively associated with firm-specific stock price crash risk. This finding is consistent with the view that real earnings smoothing helps managers withhold bad news, keep poor-performing projects, conceal resource diversion, and engage in ineffective risk management, which increases crash risk. Further, we find a stronger relation between crash risk and real earnings smoothing when firm uncertainty is higher, product market competition is lower, and balance sheet constraint is higher. Overall, our study suggests that real earnings smoothing destroys shareholder value in that it increases stock price crash risk.

KEY WORDS: Real earnings smoothing, bad news hoarding, rent extraction, and stock price crash risk

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1. Introduction

Accounting literature has long recognized that managers use their discretion to "intentionally dampen the fluctuations of their firms' earnings realizations" (Beidleman 1973, 653). They can do so through accrual-based earnings smoothing or real earnings smoothing.[1] Real smoothing involves real economic actions that managers undertake to reduce earnings volatility. It can be achieved by changing the timing or structuring of an operating, investment, or financing transaction. For instance, managers can smooth earnings by adjusting production and investment decisions (e.g., Lambert 1984; Acharya and Lambrecht 2015). However, prior research has largely focused on accrual-based earnings smoothing, and paid little attention to real smoothing, although real smoothing is more pervasive in practice than accrual-based smoothing (Lambert 1984). In a survey of chief financial officers (CFOs) by Graham, Harvey, and Rajgopal (2005), 78 percent of survey participants admit to taking value-destroying real economic actions to achieve smoother earnings. Despite the potential for real smoothing to impair shareholder value, prior studies have provided little evidence on its value implications to shareholders. To fill the void in the literature, this study examines whether and when real earnings smoothing influences firm-specific stock price crash risk, an extreme return outcome.

Real earnings smoothing could influence stock price crash risk through its impact on the flow of firm-specific information to the market as well as its impact on real decision making. Regarding the informational effect, real smoothing enables income to be overstated following negative earnings surprises, and thereby facilitates bad-news hoarding, which increases the probability of stock price crashes (Jin and Myers 2006). Also, because real smoothing can be used to manage investor expectations and limit their intervention (Acharya and Lambrecht 2015), real earnings smoothing can enable managers to keep unprofitable projects and conceal and continue resource diversion for too long, increasing the probability of stock price crashes (Bleck and Liu 2007; Kim, Li, and Zhang 2011a). In addition, real smoothing can allow managers to engage in ineffective risk management, which could increase crash risk, since real smoothing reduces investor perception about firm risk and hence the likelihood of investor intervention in risk management. Given that real smoothing can affect information flow and real activities, we expect real smoothing to be positively associated with future stock price crash risk.

[1] We use the terms "real earnings smoothing" and "real smoothing" interchangeably in the paper.

However, it is possible that our prediction may not hold empirically for several reasons. First, like accrual-based earnings smoothing, real smoothing may be used to convey private information about future firm performance and firm risk to outsiders, which could even lower stock price crash risk. Second, if real smoothing is used as a tool of risk management, it could reduce stock price crash risk. Third, to the extent real earnings smoothing underreports earnings in response to positive earnings surprises, it can also reduce crash risk by delaying the reporting of good news. Lastly, if real smoothing represents an optimal equilibrium behavior as shown in the analytical framework developed by Lambert (1984), it will not be associated with stock price crash risk. To the extent these countervailing arguments hold, they would work against finding results supporting our prediction.

To test our prediction, we follow Chen, Hong, and Stein (2001) and Kim, Li, and Zhang (2011b) to measure firm-specific crash risk using two proxies. One is the negative skewness of firm-specific weekly returns. The other measure captures "the asymmetric volatility between negative and positive firm-specific weekly returns" (Kim et al. 2011b, 714). To measure real earnings smoothing, we follow the intuition of Tucker and Zarowin (2006, 254) that "there is an underlying pre-managed income series" and that managers use their discretion to smooth reported earnings. Specifically, we derive our primary measure of real earnings smoothing by combining two metrics, one reflecting real smoothing through managerial discretion over expenses, and the other reflecting real smoothing through managerial discretion over production. The metric based on discretion over expenses (production) is measured as the negative correlation between the managed component of earnings attributed to the adjustment of discretionary expenses (production) and pre-managed earnings. We conduct tests to validate the real smoothing measure and find that our real smoothing metric is associated with lower firm-specific earnings volatility as well as lower firm-specific return volatility, suggesting that the measure captures the underlying construct.

Using U.S. data for the years 1993 through 2014, we find real earnings smoothing is positively related to one-year-ahead stock price crash risk. This result suggests that real smoothing facilitates bad-news hoarding, allows poor-performing projects to continue, conceals resource diversion, and enables ineffective risk management for extended periods, which increases crash risk. We also find that real earnings smoothing predicts future crash risk up to three years ahead. The results hold after controlling for discretionary accruals, investor heterogeneity, and several other variables identified in prior research to influence stock price crash risk. The results still hold after using alternative proxies for real earnings smoothing and crash risk.

We also conduct a battery of tests to address the endogeneity concern, including additional control variables, time-series analyses, change analysis, and instrumental/two-stage least squares estimation. Our baseline results of a positive relation between real earnings smoothing and future crash risk hold across all these tests. Nevertheless, we acknowledge that the statistical associations we document do not necessarily establish causal relations. To further shed light on how real smoothing influences crash risk, we examine the underlying mechanisms of overinvestment and resource diversion. We find that real smoothing influences crash risk through overinvestment and resource diversion, but there still exists a partial effect of real smoothing on crash risk after controlling for such economic mechanisms.

In light of the adverse consequences of real earnings smoothing documented above, we next investigate how the relation between real smoothing and future crash risk varies cross-sectionally. If real smoothing represents managerial opportunism stemming from agency conflicts between shareholders and managers, we expect the effect of real smoothing on crash risk to be more pronounced for firms with high uncertainty and more balance sheet constraints, but less pronounced for firms with high product market competition. Using stock return volatility as a proxy for firm uncertainty, net operating assets as a proxy for balance sheet constraint, and Herfindahl-Hirschman index as a proxy for product market competition, we find results consistent with the above predictions. We also find the effect of real smoothing on crash risk is mitigated when firms' credit ratings shift from minus to middle notch ratings, suggesting that real smoothing can be informative when firms have less pressure to use it to meet credit rating goals.

Our study makes several contributions. First, we contribute to prior research investigating the effects of earnings smoothing. Despite extensive evidence of income smoothing in prior research, there is little empirical research on the consequences of real earnings smoothing. One exception is Huang, Zhang, and Deis (2009), who examine the impact of real smoothing through derivative use and accrual earnings smoothing on firm value. They find that firm value increases with the level of real smoothing through derivative use, but decreases with the level of accrual earnings smoothing. Different from this study, we focus on real smoothing through the adjustment of production and discretionary expenses and investigate its impact on stock price crash risk, an extreme outcome. To the best of our knowledge, our study is the first to empirically investigate the effect of real earnings smoothing through the adjustment of production and discretionary expenses.

Our study also contributes to the growing research on stock price crash risk. Using a cross-country setting, Jin and Myers (2006) posit and find that a lack of transparency increases the likelihood of stock price crash risk. Using U.S. firms only, Hutton, Marcus, and Tehranian (2009) show similar, supportive evidence. This study notes that opaque reporting as reflected in accrual-based earnings management impairs firm information flow and, as a result, increases the likelihood of stock price crashes. Moreover, Kim and Zhang (2016) note that accounting conservatism lowers both the incentives and the ability of managers to conceal bad news. As a result, accounting conservatism is posited and found to reduce the crash risk. Different from this stream of research that focuses more on the implication of accounting choices on crash risk, we examine the impact of real decisions of managers on crash risk over and above the role of discretionary accruals. Thus, we directly shed light on real earnings smoothing as another factor that affects crash risk.

Our study is related to but distinct from Francis, Hasan, and Li (2014), who examine the impact of real earnings management on crash risk. First, we examine real smoothing resulting from both upward and downward real earnings management, while Francis et al. (2014) emphasize upward real earnings management used to meet earnings benchmarks.[2] Such a distinction is important for several reasons. Real smoothing targets earnings volatility, while real earnings management targets an earnings level. As a result, the former influences investor perception about the variance of the firm's economic earnings, while the latter influences investor perception about the mean of the firm's economic earnings. According to Goel and Thakor (2003), when the uncertainty over the variance (mean) of earnings distribution dominates the uncertainty over the mean (variance) of earnings distribution, firms are more likely to use earnings smoothing (earnings management) to keep earnings smooth (inflate earnings). The incentives underlying real smoothing and real earnings management can also differ. For instance, when managerial compensation is tied to long-run performance, managers are more likely to smooth earnings, whereas managers are more likely to inflate earnings when their compensation is tied to short-term performance. Also, real smoothing is typically used over multiple years as a long-term strategy,

[2] Surprisingly, they use the real earnings management metrics based on the moving sum of the absolute values of abnormal production, abnormal CFO, or abnormal discretionary expenses over the prior three years (except Table 9). This measurement approach can capture the effect of real earnings smoothing since the measurement uses inputs over multiple years and uses absolute values, rather than signed values over one year. With this concern, we attempt to replicate their major results in their Table 4 using signed values of real earnings management metrics over a one-year window. The results (untabulated) show no significant relation between the metrics based on signed values and crash risk. These results suggest that the major results of Francis et al. (2014) may be driven by real smoothing; and the impact of upward real earnings management is only limited to suspect firms, while the impact of real earnings smoothing extends to a much broader sample of firms.

while real earnings management is used right before a certain event (e.g., the sale of securities) as a short-term strategy.[3] Moreover, real smoothing should be more prevalent in practice than real earnings management because the ability to consistently manage earnings upward via real earnings management is limited.

Second, real earnings smoothing and real earnings management do not influence crash risk through the same channels. For instance, real smoothing can facilitate managers to continue unprofitable projects, conceal asset diversion, and engage in ineffective risk management, which in turn increase crash risk. Third, real smoothing could have a more severe impact and its impact extends to longer windows than real earnings management. One reason is that real smoothing proactively manages outsiders' expectations, which facilitates managerial opportunism over a longer period, while real earnings management reactively meets an earnings target (Acharya and Lambrecht 2015). Another reason is that in contrast to real earnings management, real smoothing tends to be used over multiple years as a long-term strategy. Nonetheless, we control for real earnings management and find that our results on real smoothing still hold.

The remainder of the paper is organized as follows. Section 2 discusses the related literature and develops the testable hypotheses. Section 3 describes the sample and variable construction and the empirical model. In section 4, we report and discuss the results. Section 5 presents robustness checks and additional analyses, and section 6 concludes the paper.

2. Related literature and hypothesis development

Role of (accrual) earnings smoothing

Earnings smoothing has merited considerable attention in the prior literature.[4] There are two competing views on the role of earnings smoothing. One view is that earnings smoothing is desirable. Earnings smoothing can reduce investors' perceptions about firm risk. A recent survey by Graham et al. (2005, 44) finds approximately 89 percent of its respondents believe "smooth earnings are perceived to be less risky by investors." In a similar vein, Trueman and Titman (1988) point to the role of earnings smoothing in reducing

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[3] This observation is analogous to the discussion in Jung, Soderstrom, and Yang (2013) about the difference between accrual-based earnings smoothing and accrual-based earnings management.

[4] For a review, see Schipper (1989), Healy and Wahlen (2000), and Dechow, Ge, and Schrand (2010).

perceived default risk and consequently improving a firm's ability to raise external funds at lower cost. More recently, Jung et al. (2013, 647) find earnings smoothing increases "the likelihood of a subsequent rating upgrade for firms with plus notch ratings."

Earnings smoothing can also convey private information about future earnings and the permanent level of earnings (e.g., Beidleman 1973; Barnea, Ronen, and Sadan 1975; Ronen and Sadan 1981; Demski 1998; Kirschenheiter and Melumad 2002; Tucker and Zarowin 2006). Consistent with this view, Dichev and Tang (2009) find smoother earnings streams are more persistent and predictive of earnings up to five years ahead. Goel and Thakor (2003) also paint a positive picture of earnings smoothing by positing that it reduces the information disadvantage of uninformed investors.

Unlike the above studies, there is growing research that advances a less optimistic view of earnings smoothing. Leuz, Nanda, and Wysocki (2003) argue that earnings smoothing can be undertaken to limit detection of managerial diversion of firm resources. Consistent with this argument, they find earnings smoothing is prevalent in settings where managers reap more private-control benefits. In a similar vein, Bhattacharya, Daouk, and Welker (2003, 649) note that smoothing accounting earnings artificially can "fail to depict the true swing in underlying firm performance, thus decreasing the informativeness of reported earnings and, hence, increasing earnings opacity." Myers, Myers, and Skinner (2007, 251) show that firms smooth earnings "to help sustain their firm's earnings strings." Moreover, Jayaraman (2008) documents that earnings smoothing is associated with higher bid-ask spreads and the probability of informed trading, suggesting that earnings smoothing garbles information and leads to higher information asymmetry between insiders and outsiders. However, McInnis (2010) does not find a statistically significant relation between income smoothing and cost of equity. Overall, there is mixed evidence on the role of earnings smoothing.

Hypothesis development

The extant literature on earnings smoothing predominantly focuses on earnings smoothing using accounting choices, that is, accrual-based earnings smoothing. In addition to accrual-based earnings smoothing, managers can smooth earnings using real activities (Lambert 1984). For instance, managers can smooth earnings by adjusting production and investment decisions (Lev and Kunitzky 1974; Lambert 1984; Liu and Espahbodi 2014; Acharya and Lambrecht 2015). Given that lower- and middle-level managers do not have the authority to choose accounting methods, earnings smoothing activities undertaken by them are more likely to be real smoothing devices (Lambert 1984). Thus, real earnings smoothing could be even more prevalent in practice.[5] Graham et al. (2005) indicate that 78 percent of the CFOs in their survey admit to real earnings smoothing. Therefore, it is crucial to understand the economic implications of real earnings smoothing as reflected in stock price crash risk.

Real earnings smoothing could influence stock price crash risk through its impact on the flow of firm-specific information to the market as well as its impact on the real decision making. With respect to the informational effect, real earnings smoothing allows income to be overstated following negative earnings surprises, and this gives managers the opportunity to conceal bad news as a way to inflate a firm's share price, at least in the short run. If bad firm-specific news is held for a long time, it has to come out eventually (Jin and Myers 2006). This revelation of bad news occurs because it is either too costly or impossible to continue withholding it. As a consequence, the sudden revelation of bad news can lead to stock price crashes.

Real smoothing can also affect crash risk via its impact on real decision making. As earnings are smoothed through real activities, investor expectations are more likely to be managed, and thereby they are less likely to intervene (Acharya and Lambrecht 2015). Specifically, managers can use real smoothing to conceal unfavorable earnings realizations in years of poor performance, thereby limiting investor intervention. In years of good performance, managers can create reserves for future periods by understating earnings, which can make reported earnings less variable and again limit investor intervention. With limited investor intervention, unprofitable projects are more likely to be kept alive for too long. As a result, these projects can continue to perform poorly, increasing the likelihood of price crashes (Bleck and Liu 2007). Moreover, with limited investor intervention, managerial asset diversion is more likely to be continued and concealed.[6] Once the asset diversion activities are detected, the sudden revelation of extensive resource diversions could cause stock price to drop sharply (Kim et al. 2011a).

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[5] Another reason for the higher prevalence is that accrual earnings smoothing is more likely to be scrutinized by audit committees, external auditors, and regulators, which constrain managers from engaging in accrual smoothing.

[6] Desai (2005, 181) notes that managerial asset diversion can take several forms, including "abuse of corporate funds for personal purposes, the abuse of loan programs, unauthorized compensation, and related party transactions."

In addition, real smoothing can influence crash risk through its effect on risk management. Since real smoothing reduces investor perception about the variance of the firm's economic earnings and firm risk,[7] investors are less likely to intervene in risk management. Without such an intervention, firms could engage in ineffective risk management, resulting in higher stock price crash risk. This line of reasoning is consistent with the argument that ineffective risk management contributed to the recent financial crisis (e.g., Bebchuk 2009; Stultz 2008).

In summary, real earnings smoothing could increase future stock price crash risk by facilitating bad news hoarding and managerial asset diversion as well as allowing negative NPV projects and ineffective risk management to be continued for too long. This leads to the following hypothesis (stated in the alternative form):

HYPOTHESIS 1. *Real earnings smoothing is positively associated with future stock price crash risk, ceteris paribus*.

We note that several countervailing factors would work against finding evidence supporting our prediction. Like accrual-based earnings smoothing, real earnings smoothing can be used to convey private information about future firm performance and firm risk to outsiders. Under such a scenario, bad news is less likely to be withheld and accumulated, lowering future stock price crash risk. In addition to traditional bad-news hoarding, accelerated recognition of good news in earnings or disclosure of good news through other channels could also increase crash risk (Kim and Zhang 2016). To the extent real earnings smoothing underreports earnings in response to positive surprises, it can also reduce future stock price crash risk by delaying the reporting of good news. Real smoothing could also reduce crash risk if it is used as a tool of risk management (Huang et al. 2009; Rountree, Weston, and Allayannis 2008). Also, real smoothing may not influence crash risk. Lambert (1984) shows analytically that an optimal compensation scheme can incentivize managers to smooth a firm's income. In this setting, the principal is not fooled by the manager's behavior and real earnings smoothing arises as optimal equilibrium behavior. Accordingly, real earnings smoothing is not associated with future stock price crash risk in this setting.

[7] Several prior studies document that earnings smoothing reduces the risk as perceived by investors (Trueman and Titman 1988; Graham et al. 2005).

Next, we investigate how the relation between real earnings smoothing and future stock price crash risk varies cross-sectionally. Under the agency framework, the conflicts between shareholders and managers lead to managerial opportunistic behavior. Therefore, the impact of real smoothing on crash risk should be stronger for firms with high uncertainty because these firms face higher ex ante agency costs (Khan and Watts 2009; Francis and Martin 2010). Managerial performance of firms operating in more uncertain environments are harder to evaluate and monitor at low cost (Demsetz and Lehn 1985). Thus, management in these firms have more flexibility in using real activities to smooth earnings, thereby further increasing future crash risk. This leads to the second hypothesis (stated in the alternative form):

> HYPOTHESIS 2. *The positive association between real earnings smoothing and future stock price crash risk is more pronounced when firm uncertainty is higher, ceteris paribus.*

We also examine the impact of competitive pressure from the product market on the relation between the real earnings smoothing and crash risk. Based on the arguments and evidence in prior research (Holmstrom 1982, Nalebuff and Stiglitz 1983, Hart 1983, and Guadalupe and Perez-Gonzales 2006), Dhaliwal et al. (2014, 1313) state that product market competition can serve "as an informal governance mechanism that constrains managers from undertaking actions that are contrary to shareholder interests."

This monitoring role of competition suggests that the impact of real earnings smoothing on crash risk should be mitigated for firms operating in competitive product markets. This leads to the third hypothesis (stated in the alternative form):

> HYPOTHESIS 3. The *positive association between real earnings smoothing and future stock price crash risk is less pronounced when product market competition is higher, ceteris paribus.*

Lastly, we examine whether balance sheet constraint affects the relation between real earnings smoothing and crash risk. Prior research shows that firms use real activities management more when there are higher costs or more constraints associated with accrual management (Cohen, Dey, and Lys 2008; Cohen and Zarowin 2010; Zang 2012). For instance, Zang (2012) shows that when firms face more balance sheet constraints, they are more likely to use real activities management. The implication is that with more balance sheet constraints, firms have fewer opportunities to smooth earnings using accruals; thus, they are more likely to smooth earnings using real activities. As a result, the relation between real earnings smoothing and crash risk should be more pronounced for firms with more balance sheet constraints. This leads to the fourth hypothesis (stated in the alternative form):

HYPOTHESIS 4. *The positive association between real earnings smoothing and future stock price crash risk is more pronounced when firms face more balance sheet constraints, ceteris paribus.*

3. Sample and empirical model

Sample and data

We identify our sample using procedures similar to those used in Cheng et al. (2015). Specifically, we begin with a sample of firms having weekly stock returns on the Center for Research in Security Prices database and annual financial data on COMPUSTAT from 1988 through 2014. We exclude financial institutions with SIC codes from 6000 to 6799 and firms in regulated industries with SIC code 4900. We then exclude (i) firm years with negative total assets and negative stockholders' equity; (ii) firms not incorporated in the United States; (iii) firms with low-priced stock (fiscal year end price less than $1); (iv) firms with less than 26 weeks of stock returns during a 12-month period ending three months after the fiscal year end; and (v) firm years with insufficient data for variables used in our empirical models. We are left with a final sample of 32,188 firm-year observations spanning the period 1993 through 2014.[8] We winsorize all variables computed as ratios that lie in the upper or lower 1 percent of the distribution.

Measuring firm-specific crash risk

In order to compute two measures of crash risk, we follow the methodology outlined in Chen et al. (2001) and used in Kim et al. (2011a; 2011b). We compute firm-specific residual weekly returns by regressing the return of firm *i* in week τ ($r_{i\tau}$) on contemporaneous and two period lagged and lead values of CRSP value-weighted market return in week τ ($r_{m\tau}$). Specifically, we estimate the following model:

$$r_{i\tau} = \alpha_i + \beta_{1i} r_{m\tau-2} + \beta_{2i} r_{m\tau-1} + \beta_{3i} r_{m\tau} + \beta_{4i} r_{m\tau+1} + \beta_{5i} r_{m\tau+2} + \varepsilon_{i\tau} . \quad (1)$$

Following Kim et al. (2011b, 717), we then transform the residuals from equation (1) "by taking the natural log

[8] We omit the years 1988 through 1992 because all independent variables in our empirical models are lagged values, and our measures of real smoothing (explained later) require five years of data.

of one plus the residuals," and label them as firm-specific weekly return (*W*).[9]

Our first measure of crash risk, *NCSKEW*, is the skewness of residual returns. Following Kim et al. (2011b, 718), we calculate *NCSKEW* "by taking the negative of the third moment of firm-specific weekly returns for each sample year and dividing it by the standard deviation of firm-specific weekly returns raised to the third power." Specifically, *NCSKEW* is computed as:

$$NCSKEW_{it} = -[n(n-1)^{3/2}\sum W^{3}_{it}] \,/\, [(n-1)(n-2)(\sum W_{it}^{2})^{3/2}] \qquad (2)$$

where *n* is the number of observations of firm-specific weekly returns during the fiscal year *t*, and other variables are defined as before. Higher values of *NCSKEW* imply that a firm's stock is more likely to crash.

Our second measure of crash risk, *DUVOL*, captures down-to-up volatility. An advantage of using this measure is that "it is less likely to be overly influenced by a handful of extreme days" (Chen et al. 2001, 711). Following Kim et al. (2011b, 718), we construct this measure by "separating all the weeks with firm-specific weekly returns below the annual mean ("down" weeks) from those with firm-specific returns above the annual mean ("up" weeks) and calculating the standard deviation of each of these subsamples separately." *DUVOL* is a natural logarithm of the standard deviation ratio of down weeks to that of up weeks defined as follows:

$$DUVOL_{it} = \log\left\{(n_u - 1)\sum_{DOWN} W_{it}^2 \,/\, (n_d - 1)\sum_{UP} W_{it}^2\right\} \qquad (3)$$

where n_u (n_d) is the number of *UP* (*DOWN*) weeks, and all other variables are defined as before. Higher values of *DUVOL* imply that a firm's stock is more likely to crash.

[9] Untabulated results using raw residual returns to estimate the measures of crash risk yield inferences similar to those reported in the paper.

Measuring real earnings smoothing

To measure real earnings smoothing, we focus on real activities undertaken to adjust discretionary expenses or production.[10] Specifically, we measure real smoothing through managerial discretion over expenses using the negative correlation between the managed component of earnings attributed to adjustment of discretionary expenses and pre-managed earnings. We define the managed component of earnings attributed to the adjustment of discretionary expenses as negative one times abnormal discretionary expenses estimated using the Roychowdhury (2006) model. Larger values of the managed component of earnings imply more income-increasing real earnings management via discretionary expenses. The pre-managed earnings are calculated as earnings minus the managed component of earnings attributed to adjustment of discretionary expenses. Next, we calculate the correlation between the managed component of earnings attributed to discretionary expenses and the pre-managed earnings over the rolling five-year window ending in the current year. To make interpretation easier, we then multiply the correlation by negative one and label it as *ES_DEXP*. Higher values of *ES_DEXP* imply more real earnings smoothing.

We measure real smoothing through managerial discretion over production using the negative correlation between the managed component of earnings attributed to adjustment of production and pre-managed earnings. We define the managed component of earnings attributed to the adjustment of production as abnormal production costs estimated using the Roychowdhury (2006) model. The pre-managed earnings are calculated as earnings minus the managed component of earnings attributed to adjustment of production. Next, we calculate the correlation between the managed component of earnings attributed to production and the pre-managed earnings over the rolling five-year window ending in the current year. To make interpretation easier, we then multiply the correlation by negative one and label it as *ES_PROD*. Higher values of *ES_PROD* imply more real earnings smoothing.

[10] Given that each real smoothing mechanism is costly, it is reasonable to assume that firms use one mechanism at a time to smooth earnings. When we relax this assumption and derive an alternative measure of real earnings smoothing that jointly considers managerial discretion over expenses and production, we find results similar to those reported in Table 3.

In order to capture the total effects of real smoothing and to mitigate measurement errors in each individual proxy for real smoothing, we add *ES_DEXP* and *ES_PROD* to derive *ES_REAL*, as our primary measure for real earnings smoothing.[11] While the values of *ES_DEXP* and *ES_PROD* can range from −1 to 1 separately, the values of *ES_REAL* range from −2 to 2.

Research design

To test Hypothesis 1, we estimate the following ordinary least squares (OLS) regression models:

$$NCSKEW_{t+1} = \alpha_0 + \beta_1 ES\_REAL_t + \sum_{q=2}^{m} \beta_q (q^{th} Control\ Variables_t) + \sum Industry + \sum Year + \varepsilon_{t+1} \quad (4)$$

$$DUVOL_{t+1} = \alpha_0 + \beta_1 ES\_REAL_t + \sum_{q=2}^{m} \beta_q (q^{th} Control\ Variables_t) + \sum Industry + \sum Year + \varepsilon_{t+1} \quad (5)$$

All regressions include industry and year fixed effects along with several control variables identified in prior literature to potentially affect crash risk (Chen et al. 2001; Hutton et al., 2009, and Kim et al. 2011a, b). They are estimated using OLS with White standard errors corrected for firm clustering. Hypothesis 1 predicts a positive association between real smoothing and future stock price crash risk. Hence β_1 is expected to be positive under Hypothesis 1.

To test Hypothesis 2, we estimate equations (4) and (5), separately, for the subsamples with high and low firm uncertainty. Following Khan and Watts (2009), we use standard deviation of daily stock returns (*DRETVOL*) to capture firm uncertainty. We classify firms with *DRETVOL* above the sample median as firms with high uncertainty, and the rest as firms with low uncertainty. Under Hypothesis 2, we expect the coefficient on *ES_REAL* to be larger for firms with high uncertainty than that for firms with low uncertainty.

[11]This approach is similar to that used by Cohen and Zarowin (2010), who combine the individual measures of real earnings management to compute a comprehensive metric of real earnings management.

To test Hypothesis 3, we estimate equations (4) and (5), separately, for the subsamples with high and low product market competition. Following Kim et al. (2011b), we measure product market competition using Herfindahl-Hirschman index (*HHI*) based on the market share of revenues of firms in an industry (3 digit SIC). We classify firms with *HHI* above the sample median as firms with low product market competition, and the rest as firms with high product market competition. Under Hypothesis 3, we expect the coefficient on *ES_REAL* to be smaller for firms with high product market competition than that for firms with low product market competition.

To test Hypothesis 4, we estimate equations (4) and (5), separately, for the subsamples with more and less balance sheet constraints. Following Hirshleifer et al. (2004), we capture balance sheet constraints using net operating assets (*NOA*). We classify firms with *NOA* above the sample median as firms with more balance sheet constraints, and the rest as firms with less balance sheet constraints. Under Hypothesis 4, we expect the coefficient on *ES_REAL* to be larger for firms with more balance sheet constraints than that for firms with less balance sheet constraints.

4. Results

Descriptive statistics

Table 1 presents descriptive statistics for several variables including the three partitioning variables. The mean value of $NCSKEW_{t+1}$ ($DUVOL_{t+1}$) is −0.090 (−0.058), which is very similar to the estimates by Kim et al. (2011b). *ES_REAL*, which captures real earnings smoothing, has a mean (median) value of 1.489 (1.702). All control variables exhibit significant cross-sectional variation as evidenced by their standard deviation.

Table 2 reports Pearson correlations among variables. Both of our future crash risk measures, $NCSKEW_{t+1}$ and $DUVOL_{t+1}$, are positively correlated with each other, suggesting that they capture similar information. The correlations of the crash risk measures with the real smoothing measure, ES_REAL_t, are positive and statistically significant, providing preliminary evidence that real smoothing is positively associated with future crash risk. Consistent with prior literature, both future crash risk measures exhibit significant correlations with several control variables in the expected direction.

Tests of Hypothesis 1

Table 3 presents the OLS regression results to test Hypothesis 1, which predicts real earnings smoothing to be positively associated with future stock price crash risk. In columns (1) through (3), we use *NCSKEW* as the dependent variable. The coefficients on *ES_REAL* are positive and highly significant, irrespective of whether we exclude or include firm-specific control variables. When we use *DUVOL* as the dependent variable in columns (4) through (6), we again find that irrespective of whether we exclude or include control variables, the coefficient on real smoothing is positive and significant. These results suggest that more real earnings smoothing is associated with higher future crash risk. In terms of economic magnitude, firms experience an estimated 0.013 (0.007) increase in future stock price crash risk, as captured by *NCSKEW* (*DUVOL*), for one standard deviation increase in real earnings smoothing.[12] Given the mean value of *NCSKEW* (*DUVOL*) is −0.090 (−0.058) as reported in Table 1, this impact appears to be economically significant.

The coefficients on the control variables are generally consistent with prior research (Chen et al. 2001; Hutton et al. 2009; Kim et al. 2011a). For example, firm share turnover, past firm-specific stock returns, firm-specific returns volatility, firm-specific return skewness, and firm size are all positively and significantly associated with future crash risk. Also, the coefficient on firm leverage is negative and significant. Further, firms with more discretionary accruals (*ABACC*) experience more crashes in the future. Overall, the results in Table 3 provide strong evidence that real earnings smoothing is positively related to future crash risk, supporting Hypothesis 1.

Tests of Hypotheses 2, 3, and 4

In this section, we test three other hypotheses, which predict the relation between real earnings smoothing and crash risk to be more pronounced for firms with high uncertainty (Hypothesis 2), less pronounced for firms with high product market competition (Hypothesis 3), and more pronounced for firms with high balance sheet constraint (Hypothesis 4). Specifically, we examine the associations between real earnings smoothing and future crash risk separately for the following subsamples: high versus low firm uncertainty, high

[12] We obtain 0.013 by multiplying 0.552 (the standard deviation of *ES_REAL*) with 0.023 (the coefficient on *ES_REAL* in column (3) of Table 3). Similarly, we obtain 0.007 by multiplying 0.552 (the standard deviation of *ES_REAL*) with 0.012 (the coefficient on *ES_REAL* in column (6) of Table 3).

versus low product market competition, and high versus low balance sheet constraints.[13]

Table 4 presents the OLS regressions for estimating equations (4) and (5) using firm uncertainty, product market competition, and balance sheet constraint as the partitioning variables. For brevity, we do not tabulate the coefficient estimates on the control variables. Irrespective of the measures for crash risk, real earnings smoothing is positively and significantly related to future crash risk for the subsample of firms with high uncertainty, but not for the subsample of firms with low uncertainty. The Wald-test statistic shows that the difference in the coefficients on *ES_REAL* between the two subsamples is highly significant. Together, these results suggest that managers of firms with high uncertainty are more likely to use real activities to smooth earnings opportunistically, leading to more future crashes.

Table 4 also shows that regardless of the proxies for crash risk, we find a positive and significant association between real earnings smoothing and future crash risk only for the subsample of firms with low product market competition. Moreover, the difference in the coefficients of real earnings smoothing variable for high and low product market competition subsamples is significant. Put together, these results are consistent with the notion that product market competition plays a strong monitoring role in constraining opportunistic real earnings smoothing, thereby reducing the stock price crash risk in the future.

In addition, Table 4 shows that whether we use *NCSKEW* or *DUVOL* as the dependent variable, we find a positive and significant association between real smoothing and future crash risk only for the subsample of firms with high balance sheet constraint. Moreover, comparisons of coefficients on the real smoothing variables across subsamples indicate a significant difference when we use *NCSKEW* as the dependent variable. In short, the evidence is generally consistent with the view that when firms face high balance sheet constraint, they are more likely to use real smoothing, which in turn increases the crash risk in the future.

[13] Untabulated results obtained by estimating our models with the main effect for the partitioning variable and its interaction with the test variable yielded similar inferences.

Overall, Table 4 provides evidence that the positive association between real earnings smoothing and future crash risk mainly comes from the subsample of firms with high uncertainty, low product market competition, and high balance sheet constraint. This evidence suggests that when information asymmetry is high and external monitoring is weak, managers have more opportunities to use real activities to smooth earnings opportunistically, thereby increasing future crash risk. When firms face more balance sheet constraints, they rely more on real activities to smooth earnings, which in turn increases future crash risk.

5. Additional analyses

Alternative measures of real earnings smoothing

In this section, we examine whether our results are robust to alternative measures of real earnings smoothing. We construct alternative measures of real smoothing based on the negative correlation of the change in a firm's pre-managed earnings and the change of its managed component of earnings due to real activities. An advantage of this approach is that the change variables are less likely to be influenced by firm attributes. Specifically, we define individual measures of real smoothing *ES_DEXPCH* **(***ES_PRODCH*) as the negative correlation between the change in the managed component of earnings attributed to the adjustment of discretionary expenses (production) and the change in pre-managed earnings. We also define an aggregate real smoothing measure *ES_REALCH* as the sum of *ES_DEXPCH* and *ES_PRODCH*. We repeat our analysis in Table 3 after sequentially replacing our primary measure of real smoothing, *ES_REAL*, with each of the alternative measures and find results (untabulated) qualitatively identical to those reported in Table 3.[14] Thus, our results are robust to alternative measures of real smoothing.

Alternative measures of stock price crash risk

We also test whether our results are robust to alternative measures of crash risk. Following Hutton et al. (2009) and Jin and Myers (2006), we construct three alternative proxies for crash risk, *CRASH*, *COUNT*, and *DOWN*. The Appendix provides more details on the variable definitions. We rerun our analyses in Table 3 using

[14] By ''qualitatively identical to those reported in Table 3,'' we mean that the coefficient β_1 is positive and significant at $p \leq 10$ percent.

each of these alternative measures sequentially. The results (untabulated) are qualitatively identical to those reported in Table 3. Thus, our primary conclusion is not sensitive to alternative measures of stock price crash risk.

Validity tests: Real earnings smoothing and volatility of firm-specific earnings/returns

For additional validation, we test whether our real earnings smoothing measure influences volatility of firm-specific earnings as well as that of firm-specific returns. Annual earnings innovation has an industry component and a firm-specific component (Ayers and Freeman 1997; Crawford, Roulstone, and So 2012). Among the multiple components, managers have the most influence over the firm-specific components. If our real smoothing measure captures smoothing driven by managerial discretion, we expect our measure to be negatively associated with volatility of firm-specific earnings. Meanwhile, when firm-specific earnings are smoothed by managers, firm-specific returns are expected to be less volatile. Prior studies document that discretionary earnings smoothing and idiosyncratic return volatility are negatively related (Chen, Huang, and Jha 2012).

To test the above conjectures, we follow Crawford et al. (2012) to capture firm-specific earnings as the difference between reported earnings and the median earnings of all firms in the same industry (same two-digit SIC). Volatility of firm-specific earnings (*STD_FIRMEAR*) is measured as the standard deviation of firm-specific earnings. Similarly, we measure firm-specific return volatility (*STD_FIRMRET*) using the standard deviation of firm-specific weekly returns (*W*) defined in section 3.[15] Given the smoothness of firm-specific performance could also be influenced by a firm's operating environment, we follow Lang et al. (2012) to control for the fundamental determinants of smoothness of firm-specific performance, including *LNASSETS*, *LEV*, *BM*, *STD_SALES*, *PCT_LOSS*, *OPCYCLE*, *SG*, *OPLEV*, and *CFO*. The Appendix provides more details on variable definitions.

[15] We take natural log of one plus firm-specific earnings volatility, while we take natural log of firm-specific return volatility.

Table 5 presents the regression results. Irrespective of whether we use *STD_FIRMEAR* or *STD_FIRMRET* as the dependent variable, the coefficients on *ES_REAL* and *ES_REALCH* are both negative and statistically significant. These results provide additional validation that our real smoothing measures identify smoothing driven by managerial discretion over real activities.[16]

Additional controls

We also investigate whether our results are robust to the inclusion of additional variables that have recently been shown to be associated with crash risk in prior research (Kim and Zhang 2016; Kim et al. 2011a; Callen and Fang 2013; Xu et al. 2013; Francis et al. 2014). The additional control variables we consider include firm-level conservatism (*CSCORE*), tax avoidance (*LRCETR*), analyst coverage (*ANAL*), institutional ownership (*IOR*), and real earnings management attempting to meet an earnings target (*SIGNAGGREMTOP5)*. The Appendix provides detailed definitions for these variables. The results (untabulated) show that our results on the real smoothing variable continue to hold after controlling for these additional variables.

Possible mechanisms

Our evidence so far shows that real earnings smoothing increases stock price crash risk in the future. To better understand how real smoothing affects crash risk, we follow the research design in prior research (e.g., He and Tian 2013; Lang, Lins, and Maffett 2012) to explore possible mechanisms through which real earnings smoothing influences crash risk. In particular, we focus on two real mechanisms, overinvestment and resource diversion. We choose to only examine real mechanisms because prior studies have documented some evidence on the informational mechanisms (e.g., Hutton et al. 2009; Li and Zhan 2016), but provide little evidence on the real mechanisms. In addition, we examine whether there still exists a partial effect of real earnings smoothing on stock price crash risk after controlling for such real mechanisms.

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[16] As a sensitivity test, we construct volatility of firm-specific earnings using the difference between firm-level reported earnings and the median earnings of all firms in the same industry and fiscal year as a metric for firm-specific earnings. We find similar results. We also test the robustness of our results to the alternative model specification by using the model specified in equation (4) and (5). We similarly find negative and statistically significant coefficients on *ES_REAL* and *ES_REALCH* whether using *STD_FIRMEAR* or *STD_FIRMRET* as the dependent variable.

Real mechanism: Overinvestment

Overinvestment can be one mechanism through which real smoothing influences crash risk. As discussed in section 2, with more real earnings smoothing, unprofitable projects are more likely to be kept alive for too long. Therefore, real smoothing can affect crash risk through its effect on overinvestment. To test this mechanism, we use the two-step approach in Richardson (2006) and Blaylock (2016) to identify overinvestment (*OVERINVEST*). Specifically, we define *OVERINVEST* as the amount of unexpected investment for firm-years that have positive values of unexpected investment and zero otherwise.

We present the results in column (1) of panel A in Table 6. The coefficient on real smoothing is significantly positive, in line with the argument that real smoothing limits investor intervention and allows overinvestments to continue. Benmelech, Kandal, and Veronesi (2010, 1771) note that because strategies such as overinvestment "cannot be kept forever, at some point the firm experiences a cash shortfall, the true state is revealed, and the stock price sharply declines." Therefore, our findings point to overinvestment as a plausible economic mechanism through which real earnings smoothing increases crash risk.

Real mechanism: Resource diversion

Resource diversion can be another mechanism. As discussed in section 2, real smoothing facilitates managers to conceal and continue resource diversion, which could cause stock price to drop sharply (Kim et al. 2011a). Thus, real smoothing can influence crash risk through its effect on resource diversion. To test this mechanism, we follow Atwood and Lewellen (2015) to use shareholder payout (*PAYOUT*) to capture resource diversion. Prior studies on payout document that self-interested managers prefer to retain cash, rather than pay it out to shareholders, to allow themselves to divert firm resources for their own private benefits or invest in pet projects (DeAngelo, DeAngelo, and Skinner 2008; Harford, Mansi, and Maxwell 2008).

We present the results in column (2) of panel A in Table 6. The coefficient on real smoothing is significantly negative, in line with the argument that real smoothing reduces shareholder payout and hence facilitates resource diversion. When the resource diversion is released suddenly, the stock price drops sharply (Kim et al. 2011a). Therefore, our findings suggest resource diversion is a plausible mechanism through which real earnings smoothing increases crash risk.

The partial effect of real earnings smoothing on stock price crash risk

While we identify two possible real mechanisms through which real earnings smoothing affects crash risk, an unanswered question remains; namely, whether there exists a partial effect of real smoothing on crash risk beyond the effect taking place through the above mechanisms. To answer this question, we directly control for these mechanisms in estimating the specifications in columns (3) and (6) of Table 3. Panel B of Table 6 presents the results. In columns (1) through (3), we use *NCSKEW* as the dependent variable. In column (1), we add *OVERINVEST* into the model specified in column (3) of Table 3, and find a significant and positive coefficient on *ES_REAL*. In column (2), we add *PAYOUT* into the model, and continue to find a significant and positive coefficient on *ES_REAL*. In column (3), we include both *OVERINVEST* and *PAYOUT*, and the results are similar. In columns (4) through (6), we use *DUVOL* as the dependent variable. We repeat the similar analyses in columns (1) through (3) and consistently find a significant and positive coefficient on *ES_REAL* in columns (4) through (6). Overall, we find that real smoothing influences crash risk through the proposed economic mechanisms of overinvestment and resource diversion, but there still exists a partial effect of real smoothing on crash risk after controlling for such mechanisms.

When real earnings smoothing can be informative

Just like accrual-based earnings smoothing, real earnings smoothing can be informative under certain circumstances. In this section, we explore the relation between real smoothing and future crash risk during periods when managers have less pressure to undertake real smoothing opportunistically. Jung et al. (2013, 650) find that "the extent of discretionary earnings smoothing becomes larger (smaller) after firms' credit ratings change to (from) plus or minus notch ratings from (to) middle notch ratings." If firms similarly engage in real smoothing in response to credit rating pressure, we expect that the adverse effect of real smoothing on crash risk to differ in the scenarios identified by Jung et al. (2013, 650); the adverse effect is exacerbated after "firms' credit ratings change to plus or minus notch ratings from middle notch ratings" (*TOPLUS* or *TOMINUS*), but becomes smaller "after firms' credit ratings change from plus or minus notch ratings to middle notch ratings"

(*FR_PLUS* or *FR_MINUS*).[17] To test this prediction, we modify models (4) and (5) by including the main effects for the four credit rating change groups (*TOPLUS*, *TOMINUS*, *FR_PLUS*, and *FR_MINUS*) along with their interactions with the real earnings smoothing proxy. The coefficients on the interaction terms are of primary interest.

Table 7 presents the regression results of the modified equations (4) and (5). Of the four interaction terms, only the coefficients on *ES_REAL×FR_MINUS* are negative and statistically significant in the two columns. These results indicate that the effect of real earnings smoothing on crash risk becomes weaker when firms' credit ratings shift from minus to middle notch ratings. The sum of the coefficients on *ES_REAL* and the interaction *ES_REAL×FR_MINUS* is negative and statistically significant. These results are consistent with the view that when managers have less pressure to undertake real smoothing opportunistically, real smoothing can be informative.

Longer forecasting windows

Since real smoothing tends to be used over multiple years as a long-term strategy, we expect the adverse impact of real smoothing on crash risk to be extended to longer windows. To test this conjecture, we estimate *NCSKEW* and *DUVOL* using firm-specific weekly returns during the two- and three-year periods. Using these crash risk measures as dependent variables, we repeat our analyses in Table 3 and find results (untabulated) showing that *ES_REAL* is significantly and positively related to the crash risk measured for both two- and three-year-ahead windows. In short, these results point to the role of real smoothing in predicting future crash risk up to three years ahead.

[17] For detailed variable definitions, see Appendix. Separately, we use the long-term issuer credit ratings complied by Standard & Poor's and reported on COMPUSTAT. Following Jung et al. (2013, 650), we require credit ratings "ranging from AA+ to CCC-." Because of this constraint, our sample size for this test is smaller.

Endogeneity concern

The primary endogeneity concern in our setting is correlated omitted variables. Real smoothing could occur in response to firm-specific factors. To address this concern, we use multiple approaches. First, we control for several firm-level variables that are documented in prior research as determinants of future crash risk such as past firm-specific return skewness and abnormal accruals. Second, a set of cross-sectional analyses also help mitigate the omitted variable concern. For an omitted variable to explain our cross-sectional results, it has to affect both real smoothing and crash risk in a certain way conditional on a partitioning variable. Third, we further control for a few other factors recently documented in crash risk literature as determinants of crash risk, for instance, conservatism, tax avoidance, and institutional ownership.

Fourth, we investigate the time-series variation of the real smoothing-crash risk relation because such time-series variation is exogeneous. Specifically, we conduct two tests. One examines whether the effect of real smoothing on crash risk differs between the recent financial crisis period (August 9, 2007 through December 31, 2010) and the pre-crisis period (February 1, 2004 through June 30, 2007).[18] We repeat our analyses in Table 3 for the two periods separately. Our results (untabulated) show that during the recent financial crisis, real smoothing significantly and positively affects future crash risk, regardless of the crash risk measures used; in contrast, before the financial crisis, real smoothing does not have a significant impact on future crash risk. The difference in the coefficients of *ES_REA*L between the two periods is significant. These results suggest that due to the exposure to extra market-wide volatility, firms have stronger incentives to conduct real smoothing, increasing the risk of stock price crashes during financial crisis.[19]

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[18] Our use of August 9, 2007 as the start of the crisis period is largely consistent with anecdotal evidence and prior research. For example, Badertscher, Burks, and Easton (2012) use 2007 as a cut-off for the crisis period in their study of impairments in the banking industry. We choose 3 years and 5 months before the crisis to ensure the length of the pre-crisis period to be similar to that of the crisis period.

[19] Several prior studies attribute the smoothing of reported earnings to managerial wish to neutralize environmental uncertainty (e.g., Kamin and Ronen 1978; Simon 1957; Cyert and March 1963).

The other time-series test examines whether the effect of real smoothing on crash risk for large firms differs between the pre-SOX (July 1, 1997 through June 30, 2002) and the post-SOX period (July 25, 2002 through August 9, 2007).[20] We repeat our analyses in Table 3 for the two periods separately. Our results (untabulated) show that real smoothing has a significantly positive impact on crash risk during the pre-SOX period for large firms, but not during the post-SOX period for large firms. These results are consistent with the notion that large firms face less scrutiny from both investors and regulators in the pre-SOX period, thereby making the effect of real smoothing on crash risk more pronounced in the pre-SOX period.

Fifth, we use change analysis to re-examine the impact of real smoothing on crash risk. Given our measure of real smoothing is built on the moving correlation over the prior five years, the within-firm variation of real smoothing is low. Thus, it will be difficult to identify the effect of real smoothing on future crash risk using the change analysis. Nevertheless, to mitigate the concern for time-constant omitted variables, we use changes from $t-1$ to t and changes from $t-2$ to $t+2$ sequentially to re-examine the effect of real smoothing on crash risk. Our results still hold.

Lastly, we use the instrumental variables/two-stage least squares (IV/2SLS) estimation method to further address endogeneity concern. In the first stage regression, we regress real earnings smoothing on the instrumental variables and the control variables in equation (4). In the second stage, we use the predicted real earnings smoothing to predict future crash risk.

To implement 2SLS approach, we use two instruments: (i) the one-year lagged value of managerial ability score constructed by Demerjian, Lev, and McVay (2012) (*MABILITY*); and (ii) the one-year lagged value of industry-year median value of asset tangibility (*TANGIBILITY*). Our use of one-year lagged specification for the two instruments is consistent with prior research (e.g., Coles, Daniel, and Naveen 2006; Boone et al. 2007; Kale, Reis, and Venkateswaran 2009; Cheng, Lee, and Shevlin 2016).

We choose managerial ability as an instrument because high-ability managers face more pressure to smooth earnings, but we are not aware of any prior research suggesting that managerial ability is associated with crash risk. Moreover, the persistent nature of the managerial ability attribute makes it less likely to be associated with

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[20] We end the post-SOX period on August 9, 2007 to avoid the confounding effect of the recent financial crisis. We trace the pre-SOX period back to July 1, 1997 to have a sample period with length similar to that of the post-SOX period. Large firms are defined as firms with market capitalization above the sample median.

future stock performance, the key variable used to derive our measures of crash risk. The choice of the second instrument is based on the intuition that managers have more opportunities to smooth earnings in industries with low asset tangibility since information asymmetry is higher for these industries (Barth, Kasznik, and McNichols 2001). Because this instrument is measured at the industry-year level, it is less likely to be influenced by a firm in a given year.

We then conduct the 2SLS estimation and the tests suggested by Larker and Rusticus (2010) to assess the relevance and validity of our instruments. The first-stage regressions results (untabulated) show a positive coefficient on managerial ability (*t*-statistic=6.46) and a negative coefficient on industry asset tangibility (*t*-statistic=-8.78), consistent with our prediction. The partial *F*-statistic of 61.54 (62.04) for the joint explanatory power of the two instruments is statistically significant when *NCSKEW* (*DUVOL)* is used as the dependent variable, suggesting that these two instruments add explanatory power to the first stage model.

The second-stage regressions results (untabulated) show that predicted real smoothing is significant and positively associated with our two crash risk measures. The tests of overidentifying restrictions fail to reject the null (Sargan χ^2=0.077 and 0.097 for *NCSKEW* and *DUVOL,* respectively), suggesting that the two instruments are exogenous. In short, the IV results lend further support that real smoothing has an adverse influence on future crash risk.

Although we have done various analyses to mitigate the correlated omitted variable concern, we acknowledge that we cannot completely rule out the possibility that a latent factor causes changes in both real earnings smoothing and stock price crash risk.

6. Conclusion

In a recent survey by Graham et al. (2005), 78 percent of CFOs admit to taking value-destroying real economic actions to achieve smoother earnings paths. Recently, Acharya and Lambrecht (2015) analytically show that real smoothing is used to manage investors' expectations to deflect intervention. Although real smoothing has the potential to impair shareholder value, prior studies have not empirically examined its value implications to shareholders. In this study, we investigate whether and when real smoothing influences stock price crash risk.

Using U.S. data for 1993 through 2014, we find a robust, positive association between real earnings smoothing and stock price crash risk over and above discretionary accruals. This result suggests that real smoothing enables managers to hide bad news, continue poor-performing projects, conceal asset diversions, and engage in ineffective risk management. However, we find the effect of real smoothing on crash risk is mitigated when firms' credit ratings shift from minus to middle notch ratings, suggesting that real smoothing can be informative when firms have less pressure to use it to meet credit rating goals. We also find the impact of real smoothing on crash risk is more pronounced when firm uncertainty is higher, product market competition is lower, and balance sheet constraint is higher. Overall, our results highlight the adverse effect of real earnings smoothing on shareholder value.

An important question unanswered in our study is the relation between real earnings smoothing and accrual earnings smoothing. It is possible that firms resort to real smoothing when they face higher costs or more constraints in undertaking accrual-based smoothing. Future research may benefit from considering the pecking order, if any, between real smoothing and accrual smoothing.

Appendix

Variable definitions

Dependent variables	
NCSKEW	Negative skewness of firm-specific weekly returns over the fiscal year.
DUVOL	Log of the ratio of the standard deviations of firm-specific weekly returns on the down weeks (weeks with firm-specific weekly returns below the mean over the fiscal year) to the standard deviation on the up weeks (weeks with firm-specific weekly returns above the mean over the fiscal year).
CRASH	An indicator variable that takes the value one for a firm-year that experiences one or more firm-specific weekly returns falling 3.09 standard deviations below the mean firm-specific weekly returns over the fiscal year, and zero otherwise.
COUNT	Number of crash weeks during the fiscal year minus the number of jump weeks during the fiscal year. If a firm-specific weekly return falling (exceeding) 3.09 standard deviations below (above) the mean firm-specific weekly returns over the fiscal year, then the corresponding week is defined as crash (jump) week.
DOWN	Number of crash weeks during the fiscal year.
Test variables	
ES_DEXP	A measure of real smoothing based on managerial discretion over the level of expenses.

ES_DEXPCH	A measure of real smoothing based on managerial discretion over the change in expenses.
ES_PROD	A measure of real smoothing based on managerial discretion over the level of production costs.
ES_PRODCH	A measure of real smoothing based on managerial discretion over the change in production costs.
ES_REAL	Sum of *ES_DEXP* and *ES_PROD*.
ES_REALCH	Sum of *ES_DEXPCH* and *ES_PRODCH*.
Control variables	
DTURN	Average monthly share turnover over the current fiscal year, minus the average monthly share turnover over the previous fiscal year, where monthly share turnover is calculated as the monthly trading volume divided by total number of shares outstanding during the month.
SIGMA	Standard deviation of the firm-specific-weekly return.
RET	Mean of firm-specific weekly returns over the fiscal year period, times 100.
SIZE	Natural log of market value of equity.
MB	Market value of equity divided by book value of equity.
LEV	Total long-term debts divided by total assets.
ROA	Income before extraordinary items divided by lagged total assets.
ABACC	Absolute value of discretionary accruals, where discretionary accruals are residuals obtained by estimating the modified Jones (1991) model in the cross section by each industry (two-digit SIC) year.
Partitioning and other variables	
DRETVOL	Standard deviation of daily stock returns.
HHI	Sum of squared market shares of all firms on COMPUSTAT in an industry (3-digit SIC). Market share is calculated based on the ratio of firm i's sales to industry j's total sales.
NOA	Difference between operating assets and operating liabilities scaled by lagged total assets.
STD_FIRMEAR	Natural log of one plus the standard deviation of firm-specific earnings over the rolling five-year window ended at the current year, where firm-specific earnings is defined as the difference between reported earnings and the median earnings of all firms in the same industry (two-digit SIC).
STD_FIRMRET	Natural log of standard deviation of firm-specific weekly returns over the fiscal year.

CSCORE	Firm-year conditional conservatism defined following Khan and Watts (2009).
LRCETR	Long-term cash effective tax rate, computed as the sum of income tax paid over the previous five years divided by the sum of a firm's pre-tax income less special items. We winsorize the values at 0 and 1.
SIGNAGGREMTOP5	An indicator that takes the value one if both *SIGNEXPTOP5* and *SIGNPRODTOP5* take the value one, and zero otherwise. *SIGNEXPTOP5* is an indicator that takes the value one if a firm's expense-related real earnings management falls in the top quintile for suspect firms, and zero otherwise. Expense-related real earnings management is defined as the signed value of the negative abnormal discretionary expenses estimated following Roychowdhury (2006). *SIGNPRODTOP5* is an indicator that takes the value of one if a firm's production-cost-related real earnings management falls in the top quintile for suspect firms, and zero otherwise. Production-cost-related real earnings management is defined as the signed value of the abnormal production cost estimated following Roychowdhury (2006). Suspect firms are firms with reported earnings that are just above zero ($0 < ROA < 0.01$) or just above last year's earnings ($0 < \Delta ROA < 0.01$).
ANAL	Natural log of 1+ (number of estimates), where the number of estimates is the number of analysts following from IBES.
IOR	Percentage of total shares outstanding held by institutional investors.
OVERINVEST	Amount of unexpected investment for firm-years that have positive values of unexpected investment and zero otherwise. Unexpected investment is the residual estimated from the following model: $INVEST_{t+1} = \alpha_0 + \beta_1 MB_t + \beta_2 ROA_t + \beta_3 CASH_t + \beta_4 AGE_t + \beta_5 LEV_t + \beta_6 LOGASSETS_t + \beta_7 INVEST_t + \sum Industry + \sum Year + \varepsilon_{t+1}$ where *MB*, *ROA*, and *LEV* are defined as before; *CASH* is cash and cash equivalents divided by lagged total assets; *AGE* is the natural log of the number of years with non-missing price in CRSP; *LOGASSETS* is the natural log of total assets; *INVEST* is the sum of capital expenditures, research and development expense, and acquisitions less proceeds from sale of fixed assets and depreciation, divided by lagged total assets.
PAYOUT	Total cash dividends paid (set to zero when missing) divided by total sales.
TOPLUS	One if a firm's credit rating changes from a middle notch to a plus notch, and zero otherwise.
TOMINUS	One if a firm's credit rating changes from a middle notch to a minus notch, and zero otherwise.
FR_PLUS	One if a firm's credit rating changes from a plus notch to a middle notch, and zero otherwise.
FR_MINUS	One if a firm's credit rating changes from a minus notch to a middle notch, and zero otherwise.

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TABLE 1

Descriptive statistics

	N	Mean	Std	25%	Median	75%
Dependent variables						
$NCSKEW_{t+1}$	32188	-0.090	0.860	-0.543	-0.113	0.326
$DUVOL_{t+1}$	32188	-0.058	0.378	-0.304	-0.069	0.177
Test variable						
ES_REAL_t	32188	1.489	0.552	1.264	1.702	1.898
Control variables						
$DTURN_t$	32188	0.002	0.080	-0.023	0.000	0.024
$NCSKEW_t$	32188	-0.079	0.821	-0.529	-0.110	0.319
$SIGMA_t$	32188	0.055	0.029	0.035	0.048	0.068
RET_t	32188	-0.190	0.295	-0.227	-0.115	-0.059
$SIZE_t$	32188	6.111	2.093	4.600	6.065	7.508
MB_t	32188	2.701	3.678	1.215	1.963	3.198
LEV_t	32188	0.169	0.178	0.004	0.129	0.269
ROA_t	32188	0.030	0.127	0.006	0.048	0.089
$ABACC_t$	32188	0.075	0.075	0.025	0.053	0.098
Partitioning variables						
$DRETVOL_t$	32188	0.032	0.017	0.020	0.028	0.039
HHI_t	32188	0.220	0.171	0.096	0.172	0.278
NOA_t	28890	0.638	0.395	0.469	0.635	0.776

Notes:

This table presents descriptive statistics for real earnings smoothing, stock price crash risk, control variables, and partitioning variables. The sample period is from 1993 to 2014. See the Appendix for detailed variable definitions.

TABLE 2

Pearson correlation matrix

		A	B	C	D	E	F	G	H	I	J	K	L
$NCSKEW_{t+1}$	A	1.000											
$DUVOL_{t+1}$	B	0.954	1.000										
		(0.00)											
ES_REAL_t	C	0.034	0.039	1.000									
		(0.00)	(0.00)										
$DTURN_t$	D	0.041	0.043	0.003	1.000								
		(0.00)	(0.00)	(0.53)									
$NCSKEW_t$	E	0.051	0.050	0.022	0.012	1.000							
		(0.00)	(0.00)	(0.00)	(0.03)								
$SIGMA_t$	F	-0.077	-0.091	-0.161	0.146	-0.049	1.000						
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)							
RET_t	G	0.068	0.077	0.112	-0.140	0.072	-0.837	1.000					
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)						
$SIZE_t$	H	0.170	0.182	0.066	0.046	0.149	-0.467	0.306	1.000				
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)					
MB_t	I	0.054	0.056	0.021	0.066	0.013	-0.051	0.028	0.254	1.000			

		(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)				
LEV$_t$	J	-0.009	-0.010	-0.042	0.034	-0.001	-0.002	-0.006	0.106	-0.041	1.000		
		(0.11)	(0.08)	(0.00)	(0.00)	(0.80)	(0.66)	(0.26)	(0.00)	(0.00)			
ROA$_t$	K	0.096	0.110	0.228	0.075	0.034	-0.373	0.289	0.272	0.074	-0.122	1.000	
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		
ABACC$_t$	L	-0.020	-0.026	-0.165	0.009	-0.016	0.284	-0.201	-0.134	0.029	-0.007	-0.378	1.000
		(0.00)	(0.00)	(0.00)	(0.11)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.18)	(0.00)	

Notes:

This table presents the Pearson correlations for the primary variables of interest. The sample period is from 1993 through 2014. See the Appendix for detailed variable definitions. *p*-values are in parentheses.

TABLE 3

The impact of real earnings smoothing on stock price crash risk (Hypothesis 1)

	Pred. sign	$NCSKEW_{t+1}$			$DUVOL_{t+1}$		
		(1)	(2)	(3)	(4)	(5)	(6)
ES_REAL_t	+	0.056***	0.021**	0.023***	0.029***	0.011***	0.012***
		(6.24)	(2.40)	(2.66)	(7.28)	(2.76)	(3.04)
$DTURN_t$	+		0.269***	0.267***		0.134***	0.132***
			(4.56)	(4.51)		(5.10)	(5.05)
$NCSKEW_t$	+		0.024***	0.024***		0.010***	0.010***
			(3.71)	(3.73)		(3.36)	(3.39)
$SIGMA_t$	+		2.119***	1.978***		0.694***	0.626**
			(4.10)	(3.87)		(2.75)	(2.51)
RET_t	+		0.178***	0.172***		0.067**	0.064**
			(3.36)	(3.33)		(2.48)	(2.43)
$SIZE_t$	+		0.064***	0.064***		0.028***	0.028***
			(19.52)	(19.42)		(19.56)	(19.45)
MB_t	+		0.001	0.000		0.000	0.000
			(0.52)	(0.34)		(0.64)	(0.43)
LEV_t	-		-0.079**	-0.074**		-0.037***	-0.035**
			(-2.53)	(-2.38)		(-2.71)	(-2.55)
ROA_t	?		0.361***	0.405***		0.184***	0.205***
			(7.95)	(8.56)		(9.54)	(10.24)
$ABACC_t$	+			0.238***			0.115***
				(3.59)			(3.91)
Constant		-0.060	-0.575***	-0.586***	-0.028	-0.244***	-0.249***
		(-1.41)	(-10.73)	(-10.95)	(-1.48)	(-10.31)	(-10.56)
N		32188	32188	32188	32188	32188	32188
Adjusted R^2		0.016	0.044	0.045	0.023	0.054	0.054

Notes:

This table presents the OLS regression results of the impact of real earnings smoothing on stock price crash risk. The sample period is from 1993 through 2014. See the Appendix for detailed variable definitions. Standard errors for the coefficient estimates are heteroskedasticity-robust and clustered by firm. The *t* statistics are reported in parentheses. Industry and year fixed effects are included in all regressions. *, **, and *** refer to significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance levels are based on two-tailed tests.

TABLE 4

Real earnings smoothing and stock price crash risk: The impact of firm uncertainty, product market competition, and balance sheet constraint (Hypotheses 2, 3, and 4)

	Firm uncertainty				Product market competition				Balance sheet constraint			
	$NCSEKW_{t+1}$		$DUVOL_{t+1}$		$NCSEKW_{t+1}$		$DUVOL_{t+1}$		$NCSEKW_{t+1}$		$DUVOL_{t+1}$	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
ES_REAL_t	0.037***	0.01	0.019***	0.006	0.009	0.040***	0.007	0.018***	0.039***	0.012	0.018***	0.009
	(3.20)	(0.77)	(3.66)	(0.90)	(0.67)	(3.37)	(1.18)	(3.38)	(3.04)	(0.92)	(3.12)	(1.53)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	15957	16231	15957	16231	16231	15957	16231	15957	14217	14673	14217	14673
Adjusted R^2	0.032	0.017	16.97	6.02	0.017	0.032	6.02	16.97	0.046	0.047	0.055	0.058
Subsample comparison												
$ES\_REAL_{high} < ES\_REAL_{low}$	*p*-value=0.069		*p*-value=0.053		*p*-value=0.036		*p*-value=0.067		*p*-value=0.067		*p*-value=0.122	

Notes:

This table presents the results of the cross-sectional analyses of the impact of real earnings smoothing on stock price crash risk. The sample period is from 1993 through 2014. See the Appendix for detailed variable definitions. Standard errors for the coefficient estimates are heteroskedasticity-robust and clustered by firm. The *t* statistics are reported in parentheses. Industry and year fixed effects are included in all regressions. *, **, and *** refer to significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance levels for comparison of coefficients are based on one-tailed tests, and those for other variables are based on two-tailed tests.

TABLE 5

Real earnings smoothing and volatility of firm-specific earnings/return

	$STD\_FIRMEAR_t$		$STD\_FIRMRET_t$	
	(1)	(2)	(3)	(4)
ES_REAL_t	-0.035***		-0.043***	
	(-27.04)		(-7.62)	
ES_REALCH_t		-0.033***		-0.040***
		(-23.05)		(-6.00)
$LNASSETS_t$	-0.005***	-0.005***	-0.101***	-0.099***
	(-12.35)	(-11.36)	(-33.56)	(-30.84)
LEV_t	-0.023***	-0.021***	0.240***	0.245***
	(-6.27)	(-5.44)	(11.12)	(10.61)
BM_t	-0.020***	-0.018***	0.060***	0.065***
	(-16.63)	(-14.05)	(7.47)	(7.52)
STD_SALES_t	0.000***	0.000***	0.000***	0.000***
	(3.04)	(3.00)	(3.90)	(3.56)
PCT_LOSS_t	0.081***	0.081***	0.489***	0.508***
	(28.74)	(27.25)	(34.83)	(33.65)
$OPCYCLE_t$	-0.001	-0.001	0.022***	0.024***
	(-1.29)	(-0.83)	(3.22)	(3.25)
SG_t	0.018***	0.015***	0.113***	0.113***
	(9.65)	(7.89)	(14.19)	(12.56)
$OPLEV_t$	-0.039***	-0.036***	-0.091***	-0.085***
	(-11.01)	(-10.16)	(-3.67)	(-3.25)
CFO_t	-0.026***	-0.019**	-0.008	-0.004
	(-3.18)	(-2.06)	(-0.32)	(-0.12)
Constant	0.145***	0.135***	-2.836***	-2.961***
	(19.58)	(17.53)	(-55.33)	(-56.38)
N	32121	28161	32121	28161
Adjusted R^2	0.438	0.424	0.511	0.511

Notes:

This table presents OLS regression results of the impact of real earnings smoothing on volatility of firm-specific earnings and that of firm-specific weekly return. The sample period is from 1993 through 2014. See the Appendix for detailed variable definitions. Standard errors for the coefficient estimates are heteroskedasticity-robust and clustered by firm. The *t* statistics are reported in parentheses. Industry and year fixed effects are included in all regressions. *, **, and *** refer to significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance levels are based on two-tailed tests.

TABLE 6

Real earnings smoothing and stock price crash risk: Possible mechanisms

Panel A: Possible real mechanisms

	$OVERINVEST_t$	$PAYOUT_t$
	(1)	(2)
ES_REAL_t	0.007***	-0.001**
	(5.12)	(-2.19)
$DTURN_t$	0.063***	0.006***
	(6.24)	(4.06)
$NCSKEW_t$	0.001	0.000
	(0.67)	(0.06)
$SIGMA_t$	0.145*	-0.268***
	(1.65)	(-5.25)
RET_t	0.017*	-0.013**
	(1.76)	(-2.26)
$SIZE_t$	0.002***	0.001***
	(3.74)	(3.29)
MB_t	0.001***	0.000***
	(3.85)	(4.22)
LEV_t	0.110***	-0.006***
	(17.63)	(-3.57)
ROA_t	0.034***	0.014***
	(2.73)	(4.57)
$ABACC_t$	0.236***	-0.003
	(12.97)	(-1.15)
Constant	-0.031***	0.023***
	(-2.70)	(6.82)
N	29413	32137
Adjusted R^2	0.06	0.12

Panel B: Partial effect after controlling for possible real mechanisms

	$NCSKEW_{t+1}$			$DUVOL_{t+1}$		
	(1)	(2)	(3)	(4)	(5)	(6)
ES_REAL_t	0.022**	0.023***	0.023**	0.011***	0.012***	0.011***
	(2.40)	(2.66)	(2.46)	(2.74)	(3.02)	(2.78)
$OVERINVEST_t$	0.203***		0.198***	0.075***		0.073***
	(4.55)		(4.42)	(3.90)		(3.80)
$PAYOUT_t$		-0.576***	-0.485**		-0.264***	-0.221**
		(-2.86)	(-2.29)		(-3.07)	(-2.45)
$DTURN_t$	0.249***	0.276***	0.260***	0.126***	0.135***	0.130***
	(3.97)	(4.67)	(4.15)	(4.55)	(5.16)	(4.67)
$NCSKEW_t$	0.022***	0.025***	0.022***	0.008***	0.010***	0.008***
	(3.18)	(3.75)	(3.25)	(2.84)	(3.38)	(2.89)
$SIGMA_t$	1.790***	1.839***	1.682***	0.541**	0.562**	0.491**
	(3.93)	(3.70)	(3.76)	(2.44)	(2.32)	(2.26)
RET_t	0.153***	0.165***	0.147***	0.056**	0.061**	0.053**
	(3.65)	(3.37)	(3.71)	(2.53)	(2.42)	(2.52)
$SIZE_t$	0.066***	0.064***	0.066***	0.029***	0.028***	0.029***
	(18.95)	(19.67)	(19.12)	(19.07)	(19.71)	(19.24)
MB_t	0.001	0.001	0.001	0.000	0.000	0.000
	(0.51)	(0.50)	(0.65)	(0.28)	(0.64)	(0.47)
LEV_t	-0.104***	-0.077**	-0.105***	-0.046***	-0.036***	-0.047***
	(-3.19)	(-2.48)	(-3.24)	(-3.23)	(-2.64)	(-3.28)
ROA_t	0.404***	0.421***	0.419***	0.205***	0.213***	0.212***
	(8.24)	(8.77)	(8.36)	(9.89)	(10.38)	(9.93)
$ABACC_t$	0.210***	0.239***	0.211***	0.109***	0.116***	0.110***
	(3.03)	(3.57)	(3.01)	(3.52)	(3.92)	(3.52)
Constant	-0.727***	-0.575***	-0.718***	-0.331***	-0.244***	-0.327***
	(-10.21)	(-10.74)	(-10.09)	(-10.11)	(-10.35)	(-10.00)
N	29413	32137	29371	29413	32137	29371
Adjusted R^2	0.046	0.045	0.046	0.055	0.055	0.055

Notes:

This table presents the OLS regression results of the possible mechanisms through which real earnings smoothing influences stock price crash risk. The sample period is from 1993 to 2011. See the Appendix for detailed variable definitions. Standard errors for the coefficient estimates are heteroskedasticity-robust and clustered by firm. The *t* statistics are reported in parentheses. Industry and year fixed effects are included in all regressions. *, **, and *** refer to significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance levels are based on two-tailed tests.

TABLE 7

Real earnings smoothing and stock price crash risk: When real earnings smoothing can be informative

	$NCSKEW_{t+1}$	$DUVOL_{t+1}$
	(1)	(2)
ES_REAL_t	0.031*	0.014*
	(1.87)	(1.89)
$TOPLUS_t$	-0.09	-0.066
	(-0.68)	(-1.11)
$ES\_REAL_t \times TOPLUS_t$	0.073	0.042
	(0.87)	(1.14)
$TOMINUS_t$	-0.146	-0.084
	(-0.77)	(-1.01)
$ES\_REAL_t \times TOMINUS_t$	0.068	0.03
	(0.70)	(0.70)
FR_PLUS_t	0.18	0.062
	(1.07)	(0.78)
$ES\_REAL_t \times FR\_PLUS_t$	-0.073	-0.026
	(-0.79)	(-0.58)
FR_MINUS_t	0.210*	0.115**
	(1.94)	(2.05)
$ES\_REAL_t \times FR\_MINUS_t$	-0.143**	-0.073**
	(-2.46)	(-2.45)
$ABACC_t$	0.268*	0.127*
	(1.83)	(1.94)
$ABACC_t \times TOPLUS_t$	0.15	0.163
	(0.23)	(0.56)
$ABACC_t \times TOMINUS_t$	1.287	0.676
	(1.23)	(1.55)
$ABACC_t \times FR\_PLUS_t$	-0.902	-0.377
	(-1.32)	(-1.22)
$ABACC_t \times FR\_MINUS_t$	-0.192	-0.094
	(-0.27)	(-0.30)
Controls	YES	YES
N	9717	9717
Adjusted R^2	0.023	0.032

Notes:

This table presents the OLS regression results on when real smoothing can be informative. The sample period is from 1993 to 2014. See the Appendix for detailed variable definitions. Standard errors for the coefficients are heteroskedasticity-robust and clustered by firm. The *t* statistics are reported in parentheses. Industry and year fixed effects are included in all regressions. *, **, and *** refer to significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Significance levels are based on two-tailed tests.