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Performance volatility, information availability, and disclosure reforms☆

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ABSTRACT

Using the 2002 Sarbanes–Oxley reform as an exogenous disclosure shock, we find that high, relative to low, volatility firms opt for lower levels of information availability pre reform and experience increases in information availability, CEO turnover-to-performance sensitivity, myopic behavior, CEO compensation with a structure tilted towards more cash pay, and a reduction in firm value post the reform. Our findings suggest that mandating high levels of information availability across the board increases managerial evaluation risk and produces additional agency costs for firms with volatile performance.

1. Introduction

Due to the separation of ownership and control, shareholders need performance information to monitor managers. Agency theories suggest that via monitoring, shareholders want to ensure that only capable managers are hired (e.g., Murphy, 1986; Nagar, 1999; Hermalin and Weisbach, 2012) and that managers exert effort to maximize shareholder value (e.g., Holmstrom, 1979; Grossman and Hart, 1983; Rogerson, 1985; Dye, 1986; Holmstrom and Milgrom, 1991). Managers, however, have a great deal of discretion in determining, and even manipulating, performance information disclosure for their own benefits (see Armstrong et al. (2010) for a review). Theories suggest that managers with more volatile performance opt for lower levels of disclosure, which result in lower levels of performance information available to shareholders, for the following two reasons.

First, high levels of information availability increase evaluation risk to managers with volatile performance (Nagar, 1999; Hermalin and Weisbach, 2009, 2012). When past firm performance is volatile, shareholders are uncertain about the manager's ability and hence rely on new performance information disclosure to gauge managerial ability and ensure that the correct manager is hired. High levels of information availability can result in high performance-driven dismissal risk to the manager when realized performance turns out to be poor. We label this the 'managerial evaluation risk' hypothesis. Second, firms with volatile performance are typically small, young and innovative. Such firms are more vulnerable to competition than are large and mature firms. High levels of information availability increase the chance that firms' proprietary knowledge and private information (e.g., cost information) are leaked to their competitors, which are especially value detrimental to such firms (Verrecchia, 1983; Hayes and Lundholm, 1996). We call this the 'proprietary information' hypothesis.

Both hypotheses predict that an exogenous disclosure shock that imposes a high level of information availability across all firms

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will have a larger impact on high volatility firms, due to their relatively low levels of information availability prior to the shock, than on low volatility firms. Accordingly, these high volatility firms will have to significantly increase their information availability after the disclosure shock.

Substantially increased performance information availability for high volatility firms due to the disclosure shock will make firm performance more informative to shareholders for managerial evaluation purpose. Accordingly, the 'managerial evaluation risk' hypothesis predicts that performance-driven managerial dismissal risk, i.e., managerial turnover-to-performance sensitivity, will increase for high volatility firms relative to low volatility firms post the disclosure shock. Anticipating higher performance-driven dismissal risk, managers of high volatility firms will become more myopic and cut discretionary expenses, such as R&D expenses, to boost short-term performance. They will also demand higher pay to compensate for the increased performance-driven dismissal risk (Peters and Wagner, 2014). Moreover, due to the long-term nature of equity-based compensation and the increased managerial short-termism post the disclosure shock, managers of high volatility firms may demand higher cash pay rather than equity pay. It is known that managerial myopic behavior, such as cutting R&D projects, imposes additional agency costs to shareholders and can be related to lower firm value (e.g., Stein, 1989; Jensen, 2005; Chan et al., 2001; Bhojraj et al., 2009). Higher total managerial compensation with a structure tilted towards more cash pay can also be related to lower firm value (e.g., Jensen and Meckling, 1976; Core and Larcker, 2002; Ittner et al., 2003). Thus, 'managerial evaluation risk' hypothesis predicts that firms with high performance volatility, relative to those with low volatility, may experience a reduction in firm value post the disclosure shock.

Alternatively, conditional on low levels of information availability for high volatility firms prior to the disclosure shock, significantly increased information availability as a result of the shock may enable shareholders to monitor managers of these firms closely and force them to increase their costly effort levels (Holmstrom, 1979; Dye, 1986). We label this the 'managerial effort' hypothesis. Under this alternative hypothesis, increased managerial effort should lead to an increase in firm value for high, relative to, low volatility firms post the disclosure shock. In addition, managers of high volatility firms may demand higher pay post the shock to compensate for the increased levels of costly effort. However, this hypothesis is silent on the changes in managerial turnover-to-performance sensitivity and managerial myopic behavior.

The 'proprietary information' hypothesis predicts that high, relative to low, volatility firms will cut more on R&D expenses post the disclosure shock, since proprietary knowledge and private production information generated by R&D projects are easier to be leaked to competitors after the mandated increase in information availability of high volatility firms. Such a reduction in R&D can be associated with lower firm value for high volatility firms. This hypothesis is, however, silent on the changes in managerial turnover-to-performance sensitivity and executive compensation. According to this hypothesis, we expect the effects of the disclosure shock should concentrate on firms with high levels of proprietary information prior to the shock, such as those with high R&D expenses.

In this paper, we mainly use the 2002 Sarbanes–Oxley Act (SOX hereafter) as the exogenous shock to the level of information availability to examine the above hypotheses. As a major disclosure reform aimed to impose high levels of information availability across all firms by requiring CEO and CFO certification of the reliability of financial statements, significantly increasing misreporting penalties, requiring reporting of off-balance-sheet financing and special purpose entities, mandating disclosure of internal control weaknesses, and so forth, SOX is an ideal setting for the purpose of this study. Our empirical evidence strongly suggests that firms with high, relative to low, performance volatility opt for lower levels of pre-SOX information availability as proxied by higher analyst forecast dispersion, higher stock return synchronicity, and lower future cash flow informativeness of accounting accruals. Post the SOX reform, such high volatility firms experience significantly greater increase in information availability relative to low volatility firms. Meanwhile, these firms also experience an additional increase in performance-driven forced CEO turnover (i.e., an additional increase in CEO turnover-to-performance sensitivity), a larger decline in R&D expenses, a greater increase in CEO total compensation with the structure tilted towards more cash pay, and a larger decline in firm value.

The above findings are consistent with the 'managerial evaluation risk' hypothesis. The 'proprietary information' hypothesis can potentially explain the findings on information availability, R&D expenses and firm value, but not those on managerial compensation and CEO turnover-to-performance sensitivity. In addition to not being able to explain the findings on managerial turnover-to-performance sensitivity and myopic behavior, the 'managerial effort' hypothesis contradicts the finding that high, relative to low, volatility firms experience a decline in firm value post SOX. This result is particularly interesting because when swiftly enacting SOX into law in response to a wave of corporate governance scandals at the turn of the new millennium, regulators believe that tougher disclosure requirements mandating a high level of information availability across the board will surely improve shareholder welfare particularly for those firms with low pre-SOX information availability.

To examine the robustness of the findings, we further study another disclosure reform – the U.S. Securities and Exchange Commission (SEC)'s imposition in 1970 of mandatory quarterly reporting across all firms. As it requires firms providing semiannual performance reporting to increase their reporting frequency to the quarterly level, this reform provides another ideal setting for this study. As with the SOX reform, we find the consequences for firms forced to report more frequently to not be universal. Firms with high, relative to low, performance volatility experience an additional increase in information availability; however, such high volatility firms also experience an incremental decline in R&D expenses and firm value post the 1970 reform. Our results in both the SOX- and 1970-reform settings are robust to using different performance volatility and information availability measures. Moreover, when we exclude high R&D firms, which arguably have high levels of proprietary information, from both the SOX- and 1970-reform samples, our findings do not change in any qualitative manner, suggesting that the 'proprietary information' hypothesis is unlikely to be the main driver of the findings. Finally, we show that the findings are unlikely to be explained by alternative stories such as the pre-existing trends, the confounding events surrounding the SOX reform, the firm life-cycle explanation, etc.

This paper makes several contributions to the literature. First, the literature on corporate disclosure suggests that equity-based compensation, capital market transactions and corporate control contests are important determinants of corporate disclosure and information availability (see Armstrong et al. (2010) and Beyer et al. (2010) for reviews). We add to this strand of literature by documenting a new determinant of information availability, i.e., performance volatility. The literature documents various costs and benefits of increasing information availability such as higher proprietary information costs, higher liquidity and lower cost of capital. We document another downside of increasing information availability, i.e., the increased managerial evaluation risk and associated agency costs for firms with volatile performance.

Second, we contribute to the extant findings on the SOX reform. Whereas Cohen et al. (2008) find the level of performance

information availability (e.g., earnings quality) to significantly increase post SOX, we show this effect increases with the level of pre-SOX performance volatility. Bargeron et al. (2010) and Cohen et al. (2013) find R&D expenses to significantly decline post SOX. Guthrie et al. (2012) find the SOX requirement regarding compensation committee independence to increase CEO compensation. We show that the magnitudes of post-SOX changes in R&D expenses and CEO compensation also increase in the level of pre-SOX performance volatility. Zhang (2007) and Li (2014) document negative consequences of SOX on U.S. firms as well as cross-listed foreign private issuers. We document a post-SOX value reduction for high, relative to low, volatility firms, consistent with the 'managerial evaluation risk' hypothesis.

Last but not least, our evidence contributes to the debate on disclosure reforms. On the one hand, some studies argue that disclosure reforms are necessary as they help shareholders better monitor managers, especially for opaque firms. For example, several studies find that SOX leads to less managerial misconduct and reduces agency costs (Klock et al., 2005; Jain and Rezaee, 2006; Chava et al., 2010; Nejadmalayeri et al., 2013; Andrade et al., 2014). On the other hand, other studies document negative consequences of SOX (Zhang, 2007; Li, 2014). In line with the latter view, we show that mandating high information availability across the board imposes additional agency costs, as reflected by more myopic behavior and higher managerial compensation, and is associated with a reduction in firm value, particularly for high volatility firms. Our findings contribute to the growing literature on the consequences of disclosure reforms (e.g., Butler et al., 2007; Fu et al., 2012; Jin et al., 2013).

The remainder of the paper proceeds as follows. Research design is described in Section 2. Results based on the SOX reform are presented in Section 3. Results based on the 1970 mandatory quarterly-reporting reform are reported in Section 4. Other robustness results are provided in Section 5. Section 6 concludes. Variable definitions and additional evidence are provided in the Appendix.

2. Research design

To study the heterogeneous impact of a reform on firms with different levels of pre-reform performance volatility, we mainly estimate the following difference-in-differences regression model:

$$Dependent_{i,t} = \alpha + \beta_1 Vol_i * Post_{i,t} + \beta_2 Vol_i + \beta_3 Post_{i,t} + \beta_4 Controls_{i,t-1} + \ fixed\_effects + \varepsilon_{i,t.} \quad (1)$$

Vol is the performance volatility of the firm in the pre-reform period; *Post* is a dummy that equals 1 if the current fiscal year of observation belongs to the post-reform period and 0 otherwise. Our main focus is on the regression coefficient of the interaction term *Vol*Post*, which captures the heterogeneous effect of the reform on the dependent variable across firms with different levels of pre-reform performance volatility. Note that all of our sample firms are subject to the reform; our "difference-in-differences" design hence differs from the traditional "difference-in-differences" approach in that our focus is on the difference in the changes in the dependent variable around the reform *across firms with different levels of pre-reform volatility*, not across treatment versus control firms as in the traditional approach. Any contemporaneous events around the reform that affect all firms to the same degree are excluded from the difference in differences.

Industry-adjusted stock returns and industry-adjusted accounting performance provide the most important metrics regarding a firm's performance relative to its industry peers (Demerjian et al., 2012). We hence use pre-reform industry-adjusted stock return volatility or industry-adjusted ROA volatility as our primary volatility proxy, which is the time-series standard deviation of the firm's industry-adjusted annual stock returns or ROA *in the pre-reform period*. We apply Fama-French 48 industry classification when computing industry-adjusted stock return or ROA volatility. At least three observations are required in the pre-reform period to calculate both volatilities. The two performance volatility measures are highly correlated and highly persistent over time.[1]

3. Main evidence from the SOX reform

Our SOX-reform sample consists of firms covered by the Execucomp database and encompasses two subperiods, the pre-reform period of 1992–1999 and post-reform period of 2004–2007. We skip the 2000–2003 period because (1) it is marked by turbulence (e.g., the burst of Internet bubble and NASDAQ crash) and (2) one of the main SOX sections on disclosure, section 404, became effective after 2004. The sample stops at 2007 to avoid the confounding events of the financial crisis that began in 2008. The results remain qualitatively unchanged when we add the 2000–2003 period to the sample and redefine, as from 1992 to 2001, the pre-reform, and from 2002 to 2007 the post-reform, period, or when we use as the pre-reform period the period (1996–1999) with the same length as the post-reform period (2004–2007). We further impose the following three sample selection criteria: (1) all firm-year observations should have enough CRSP/Compustat/Execucomp data to calculate all relevant variables detailed in the next subsection, (2) all sample firms in the pre-reform period should survive into the post-reform period, and (3) end-of-fiscal-year market capitalizations for all firm-year observations should be greater than US$200 million. We impose the second restriction because we want to examine the time-series effects of the reform on the sample firms. We impose the third restriction in order to ensure that all sample firms are subjected to SOX section 404 in the post-reform period. The results remain qualitatively unchanged when we use different cutoff points ($150 million and $300 million) or lift the restriction entirely. The final regression sample consists of 1078 unique firms and 7259 firm-year observations.

Panel A of Table 1 provides the summary statistics for the SOX-reform sample. Table A1 in the Appendix provides detailed variable definitions. To mitigate the potential influence of extreme observations, we winsorize all variables without natural bounds at the 1 and 99 percentiles. The findings are insensitive to winsorization, however.

3.1. Determinants of pre-reform performance volatility

We first use OLS regressions to examine the determinants of pre-reform performance volatility. The dependent variable is pre-SOX industry-adjusted stock return or ROA volatility. We follow Dichev and Tang (2009) in selecting the independent variables, which include firm size (*Size*), firm age (*FirmAge*), business diversification (*Divers*), fundamental correlation between firm performance and industry performance (*Fundcorr*), operating cycle length (*Cycle*), sales growth (*SG*), and innovation intensity (*R&D*). We include industry (using Fama-French 48 industry classification) and year fixed effects to control for the potential differences across industries and time, respectively, and cluster the standard errors at the firm level.

Smaller firms, younger firms, firms that are less diversified, firms with greater growth opportunities, and more innovative

[1] The correlation between industry-adjusted stock return volatility and industry-adjusted ROA volatility is 0.676, which is highly significant (P-value 0.000). The pre-reform volatility of a firm is also highly correlated with its post-reform volatility (e.g., the correlations before and after SOX based on industry-adjusted stock return volatility and industry-adjusted ROA volatility are 0.870 and 0.902, respectively; P-value 0.000).

Table 1
Descriptive statistics.

Variable	Mean	Std Dev	10%	25%	Median	75%	90%
Panel A: The SOX-reform sample							
Dispersion	0.072	0.099	0.010	0.020	0.040	0.080	0.204
Synch	0.620	0.628	0.106	0.207	0.416	0.787	1.395
CFO	0.120	0.091	0.030	0.070	0.112	0.164	0.227
TA	−0.033	0.065	−0.102	−0.066	−0.037	−0.006	0.038
Turnover (indicator)	0.040	0.195	0	0	0	0	0
R&D	0.044	0.069	0	0	0.016	0.062	0.094
Pay (%)	0.132	0.165	0.016	0.035	0.078	0.160	0.304
Cash Pay (%)	0.113	0.135	0.015	0.032	0.070	0.138	0.251
Equity Pay (%)	0.016	0.056	0	0	0	0	0.044
Q	2.022	1.425	1.045	1.230	1.603	2.293	3.388
Vol_RET	0.327	0.235	0.117	0.166	0.255	0.408	0.624
Vol_ROA	0.032	0.029	0.009	0.014	0.023	0.038	0.063
Post	0.406	0.491	0	0	0	1	1
Size	7.694	1.460	5.915	6.594	7.568	8.608	9.692
FirmAge	29.948	15.168	10	15	31	44	49
Divers	0.533	0.350	0.136	0.231	0.346	1	1
Fundcorr	−2.145	2.497	−5.370	−3.451	−1.845	−0.497	0.697
Cycle	0.467	1.425	0.130	0.195	0.295	0.425	0.606
SG	0.145	0.356	−0.034	0.030	0.097	0.191	0.352
ROA	0.058	0.077	0.003	0.029	0.056	0.092	0.131
EPSchg	1.069	1.658	0.080	0.210	0.500	1.160	2.560
Roecorr	0.052	0.393	−0.467	−0.217	0.067	0.336	0.550
log(Herf)	−1.574	0.837	−2.850	−2.132	−1.454	−0.944	−0.550
log(Nind)	2.879	1.246	1.386	1.887	2.708	3.752	4.792
Retcorr	0.556	0.175	0.307	0.443	0.586	0.689	0.758
InsTrd(%)	31.365	55.849	0.732	3.074	10.791	33.08	79.287
Inst(%)	19.505	28.23	0	0	14.361	46.467	66.285
log(Nrev)	3.294	1.376	1.099	2.773	3.584	4.234	4.779
RetDif	0.119	0.454	−0.303	−0.109	0.049	0.257	0.411
RetInd	0.227	0.196	−0.194	0.103	0.195	0.328	0.148
Lev	0.523	0.187	0.255	0.397	0.538	0.651	0.752
BM	0.480	0.290	0.178	0.275	0.422	0.627	0.852
Age (indicator)	0.312	0.463	0	0	0	1	1
AG	0.151	0.333	−0.045	0.015	0.084	0.187	0.366
Panel B: The 1970-reform sample							
Synch	0.345	0.334	0.065	0.125	0.236	0.436	0.764
R&D	0.010	0.218	0	0	0	0	0.042
Q	1.346	1.516	0.694	0.715	0.929	1.202	2.256
Vol_RET	0.347	0.392	0.084	0.147	0.230	0.397	0.683
Vol_ROA	0.031	0.252	0.008	0.010	0.016	0.027	0.049
Post	0.593	0.491	0	0	1	1	1
Size	3.738	5.082	1.744	1.866	2.224	3.512	6.355
FirmAge	8.124	6.78	0	2	7	13	17
Fundcorr	−0.263	4.763	−4.108	−2.212	−0.623	0.849	2.321
Cycle	0.656	19.387	0.132	0.245	0.367	0.515	0.721
SG	0.091	0.231	−0.054	−0.016	0.059	0.141	0.407
ROA	0.042	0.052	0.005	0.023	0.042	0.069	0.114
log(Herf)	−2.423	0.872	−3.513	−3.099	−2.497	−1.788	−1.181
log(Nind)	4.586	0.889	3.391	4.063	4.625	5.084	5.667
Retcorr	0.786	0.130	0.609	0.721	0.816	0.886	0.922
Lev	0.450	0.195	0.213	0.305	0.443	0.583	0.745
AG	0.098	0.227	−0.040	0.001	0.052	0.127	0.397

The table provides the descriptive statistics for the variables used in the paper. Panel A (Panel B) is based on the SOX-reform (1970-reform) sample with 7259 (835) firm-year observations.

firms are expected to demonstrate greater performance volatility since such firms tend to be less mature. In addition, we expect firms with longer operating cycle and firms that show higher performance comovement with their industry peers to demonstrate higher performance volatility since such firms are more likely to be subject to the impact of volatile economic environment.

Columns 1 and 2 of Table 2 report the results based on industry-adjusted stock return volatility and industry-adjusted ROA volatility, separately. Consistent with our expectation, the coefficients on *Size* and *FirmAge* are significantly negative, while the coefficients of *R&D* are significantly positive. Other variables show either mixed or insignificant results. Thus, the evidence suggests that smaller firms, younger firms and more innovative firms indeed have higher pre-SOX performance volatility.

3.2. Heterogeneous impact of SOX on firms with different levels of pre-SOX performance volatility

Next, we examine the heterogeneous impact of SOX on information availability, CEO turnover-to-performance sensitivity, managerial myopic behavior, CEO compensation, and firm value across firms with different levels of pre-SOX performance volatility. We include industry or firm fixed effects in all difference-in-differences regression models to control for cross-sectional differences (such as the differences in any uncontrolled firm characteristics in the data) and include year fixed effects to control for time-series differences (such as the effect of any time trend in the data). T-statistics or Z-statistics (in parentheses) are calculated using firm-clustering and heteroscedasticity robust standard errors.

Table 2
Determinants of performance volatility.

$Vol_{i,t} = \alpha + \beta_1 Size_{i,t-1} + \beta_2 FirmAge_{i,t-1} + \beta_3 Divers_{i,t-1} + \beta_4 Fundcorr_{i,t-1} + \beta_5 Cycle_{i,t-1} + \beta_6 SG_{,t-1} + \beta_7 R\&D_{i,t-1} + fixed\_effects + \varepsilon_{i,t}$

Variable	SOX-reform sample		1970-reform sample	
	Vol = Vol_RET	Vol = Vol_ROA	Vol = Vol_RET	Vol = Vol_ROA
	(1)	(2)	(3)	(4)
Size	−0.031***(−5.46)	−0.002***(−2.60)	−0.025***(−3.60)	−0.003***(−7.16)
FirmAge	−0.003***(−5.40)	−0.001***(−3.03)	−0.013***(−2.90)	−0.001** (−2.06)
Divers	−0.001 (−0.07)	0.002 (0.81)		
Fundcorr	−0.001 (−0.51)	0.000 (0.53)	0.001 (0.63)	0.000 (1.58)
Cycle	−0.000 (−0.01)	−0.001* (−1.92)	0.004 (0.33)	0.001 (1.12)
SG	0.135***(4.87)	−0.004 (−0.89)	0.158* (1.79)	0.001 (0.30)
R&D	0.306*** (4.46)	0.126***(3.97)	0.001 (0.29)	0.000 (0.62)
Intercept	Included	Included	Included	Included
Fixed effects	Ind./Year	Ind./Year	Ind./Year	Ind./Year
Adj. R^2	45.39%	30.29%	16.11%	26.96%
# obs.	2947	2947	495	495

The table provides the industry/year fixed-effect regression results with performance volatility (*Vol*) as dependent variable based on the sample in the pre-reform period. All variables are defined in Table A1 in the Appendix. T-statistics are calculated using firm-clustering and heteroscedasticity robust standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

3.2.1. Information availability

We use three measures to capture information availability. The first measure is the dispersion of analysts' earnings forecasts. According to Lang and Lundholm (1996) and Dhaliwal et al. (2011), the main source of analysts' earnings forecast dispersion is the difference in their private information—less available public information results in analysts relying more on their private information to make earnings forecasts and hence leads to higher forecast dispersion. Thus, higher analyst forecast dispersion suggests *lower* level of information availability. Analyst earnings forecast dispersion (*Dispersion*) is calculated as the 12-month average of the inter-analyst standard deviation of analyst earnings forecasts.

The second measure is stock return synchronicity. Starting from Roll (1988), R^2 obtained from the regression of individual stock returns on the market returns and industry returns has been widely used as a reverse measure of firm-specific information availability—higher R^2 means higher synchronicity and thus lower level of firm-specific information availability (Morck et al., 2000; Piotroski and Roulstone, 2004; Chan and Hameed, 2006). To measure stock return synchronicity, we first run the following regression for each firm and year:

$$RET_{i,t} = \alpha + \beta_1 MARET_{i,t} + \beta_2 MARET_{i,t-1} + \beta_3 INDRET_{i,t} + \beta_4 INDRET_{i,t-1} + \varepsilon_{i,t.} \quad (2)$$

where *RET* is the weekly stock return of the firm, *MARET* the value-weighted weekly market return, and *INDRET* the Fama-French 48 industry (to which the firm belongs) value-weighted weekly return. The R^2 obtained from Eq. (2) captures the proportion of the variation in weekly stock returns that are explained by the market and industry returns. Following Morck et al. (2000) and others, we use $\log(R^2/(1- R^2))$ (*Synch*) as the *inverse* measure of information availability.

The third measure we use to infer the level of information availability is the informativeness of accounting accruals on future cash flows of the firm (Minnis, 2011). As the most important performance metric disclosed by the firm to shareholders, earnings can be decomposed into two components: cash flows and accounting accruals. Accounting accruals are recognized into earnings in the current period and should be converted into cash flows in future periods. The more informative accounting accruals on the firm's future cash flows, the greater the level of performance information available to investors. We thus take an ex-ante perspective and measure information availability as the ability of accounting accruals to predict future cash flows of the firm. The following regression model is estimated.

$$\begin{aligned} CFO_{i,t+1} = {} & \alpha + \beta_1 TA_{i,t} * Vol_i * Post_t + \beta_2 TA_{i,t} * Vol_i \\ & + \beta_3 TA_{i,t} * Post_t + \beta_4 TA_{i,t} + \beta_5 CFO_{i,t} * Vol_i * \\ & Post_t + \beta_6 CFO_{i,t} * Vol_i + \beta_7 CFO_{i,t} * Post_t + \beta_8 CFO_{i,t} \\ & + \beta_9 Vol_i * Post_t + \beta_{10} Vol_i + \beta_{11} Post_t \\ & + fixed\_effects + \varepsilon_{i,t.} \end{aligned} \quad (3)$$

In Eq. (3), CFO is cash flow from operations excluding extraordinary items as a ratio of beginning total assets. We follow Sloan (1996) in measuring total accruals, *TA*, as

$$TA = \Delta AR + \Delta INV + \Delta OCA - \Delta AP - \Delta OCL - DP,$$

where ΔAR is the change in total receivables (Compustat item: *RECT*), ΔINV is the change in total inventories (Compustat item: *INVT*), ΔOCA is the change in total other current assets (Compustat item: *ACO*), ΔAP is the change in (trade) accounts payable (Compustat item: *AP*), ΔOCL is the change in total other current liabilities (Compustat item: *LCO*), and DP is depreciation and amortization (Compustat item: *DP*). The three-way interaction term, *TA*Vol*Post*, captures the heterogeneous impact of SOX on future cash flow informativeness of accounting accruals across firms with different levels of pre-SOX performance volatility.

Table 3 presents the results on the heterogeneous impact of SOX on information availability. They are separated according to the definition of pre-SOX performance volatility. Those based on industry-adjusted stock return (ROA) volatility are presented in columns 1–4 (columns 5–8). Panel A reports the results from difference-in-differences regressions that investigate the heterogeneous impact of SOX on analyst forecast dispersion (*Dispersion*) across firms with different pre-SOX volatility according to Eq. (1). We follow prior literature in selecting the control variables (Lang and Lundholm, 1996; Dhaliwal et al., 2011). *Size* is included since larger firms may have higher level of information availability (Diamond and Verrecchia, 1991). *ROA* is included as more profitable firms may be willing to disclose more performance information. *EPSchg* and *R&D* are included since it can be more difficult for analysts to accurately forecast earnings from firms with larger absolute changes in earnings per share from last year and greater R&D intensity. Thus, analyst forecast dispersion can be higher for such firms. *Roecorr* is included to control for analysts' tendency to cover firms with high ROE-return correlation, which makes it easier to forecast earnings based on stock returns (King et al., 1990).

Table 3
Information availability as dependent variable.

Variable	Vol = *Vol_RET*				Vol = *Vol_ROA*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Analyst forecast dispersion (*Dispersion*) as the proxy of information availability								
$Dispersion_{i,t} = \alpha + \beta_1 Vol_i{*}Post_t + \beta_2 Vol_i + \beta_3 Post_t + \beta_4 Size_{i,t-1} + \beta_5 ROA_{i,t} + \beta_6 EPSchg_{i,t} + \beta_7 R\&D_{i,t} + \beta_8 Retcorr_{i,t} + fixed\_effects + \varepsilon_{i,t}$								
Vol*Post	−0.055***(−2.65)	−0.051** (−2.42)	−0.040***(−3.46)	−0.036***(−3.12)	−0.408** (−2.36)	−0.393** (−2.29)	−0.546***(−5.90)	−0.537***(−5.82)
Vol	0.054** (2.39)	0.049** (2.12)			0.468***(2.94)	0.450***(2.86)		
Post	0.043***(4.41)		0.036***(6.87)		0.039***(4.55)		0.042***(8.67)	
Size	−0.010***(−3.32)	−0.009***(−2.94)	−0.022***(−8.40)	−0.018***(−6.01)	−0.009***(−3.04)	−0.008***(−2.72)	−0.020***(−7.91)	−0.016***(−5.44)
ROA	−0.248***(−3.87)	−0.252***(−3.93)	−0.102***(−3.34)	−0.101***(−3.25)	−0.224***(−3.57)	−0.229***(−3.64)	−0.086***(−2.84)	−0.084***(−2.72)
EPSchg	0.022***(6.77)	0.022***(6.79)	0.011***(11.24)	0.011***(11.19)	0.021***(6.55)	0.021***(6.57)	0.011***(11.00)	0.011***(10.94)
R&D	−0.025 (−0.34)	−0.017 (−0.23)	−0.028 (−0.55)	−0.024 (−0.47)	−0.052 (−0.75)	−0.043 (−0.64)	−0.065 (−1.28)	−0.063 (−1.24)
Roecorr	0.002 (0.33)	0.001 (0.25)	0.001 (0.38)	0.001 (0.41)	0.003 (0.59)	0.002 (0.47)	0.002 (0.57)	0.002 (0.57)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	20.56%	20.88%	68.93%	69.20%	20.70%	21.05%	69.11%	69.38%
#Obs.	7259	7259	7259	7259	7259	7259	7259	7259
Panel B: Stock return synchronicity (*Synch*) as the proxy of information availability								
$Synch_{i,t} = \alpha + \beta_1 Vol_i{*}Post_t + \beta_2 Vol_i + \beta_3 Post_t + \beta_4 Size_{i,t-1} + \beta_5 Divers_{i,t-1} + \beta_6 Fundcorr_{i,t-1} + \beta_7 \log(Herf_{i,t-1}) + \beta_8 \log(Nind_{i,t-1}) + \beta_9 Retcorr_{i,t-1} + \beta_{10} InsTrd_{i,t} + \beta_{11} Inst_{i,t} + \beta_{12} Nrev_{i,t} + fixed\_effects + \varepsilon_{i,t}$								
Vol*Post	−0.373***(−4.60)	−0.362***(−4.52)	−0.324***(−4.61)	−0.314***(−4.50)	−2.656***(−4.05)	−2.576***(−3.94)	−3.172***(−5.36)	−3.102***(−5.30)
Vol	0.137** (2.00)	0.128* (1.90)			0.144** (2.35)	0.166** (2.40)		
Post	0.319***(6.55)		0.275***(7.91)		0.275***(6.55)		0.266***(8.49)	
Size	0.101***(8.86)	0.100***(8.56)	0.036** (2.11)	0.025 (1.33)	0.097***(8.72)	0.095***(8.38)	0.032* (1.90)	0.018 (0.97)
Divers	0.004 (0.11)	−0.002 (−0.04)	−0.048 (−1.53)	−0.058 (−1.52)	0.006 (0.15)	0.003 (0.06)	−0.048 (−1.55)	−0.054 (−1.43)
Fundcorr	0.008* (1.96)	0.007* (1.70)	0.004 (1.07)	0.002 (0.73)	0.007* (1.75)	0.006 (1.50)	0.003 (0.85)	0.002 (0.52)
log(Herf)	−0.142***(−6.43)	−0.142***(−6.44)	−0.020 (−0.84)	−0.019 (−0.82)	−0.146***(−6.73)	−0.146***(−6.73)	−0.019 (−0.81)	−0.018 (−0.77)
log(Nind)	−0.063***(−3.58)	−0.065***(−3.73)	−0.044** (−2.12)	−0.050** (−2.45)	−0.058***(−3.35)	−0.060***(−3.51)	−0.036* (−1.71)	−0.042** (−2.04)
Retcorr	0.172** (2.53)	0.220***(2.69)	0.238***(4.28)	0.320***(5.23)	0.156** (2.30)	0.199** (2.43)	0.224***(4.05)	0.301***(4.92)
InsTrd	−0.026*** (−3.02)	−0.023*** (−2.86)	−0.029*** (−3.17)	−0.028*** (−3.10)	−0.022** (−2.36)	−0.031*** (−3.13)	−0.025*** (−2.98)	−0.028*** (−3.04)
Inst	−0.038** (−2.28)	−0.043** (−2.06)	−0.063*** (−2.68)	−0.039** (−2.31)	−0.041** (−2.01)	−0.040** (−1.99)	−0.079*** (−2.97)	−0.040** (−2.32)
Nrev	0.032** (2.22)	0.034** (2.30)	0.012*** (2.72)	0.008** (0.49)	0.037** (2.50)	0.040** (2.59)	0.012*** (2.75)	0.008** (2.49)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	35.71%	36.71%	58.74%	59.86%	35.93%	36.93%	59.03%	60.14%
#Obs.	7259	7259	7259	7259	7259	7259	7259	7259
Panel C: Cash flow informativeness of accounting accruals as the proxy of information availability								
$CFO_{i,t+1} = \alpha + \beta_1 TA_{i,t}{*}Vol_i{*}Post_t + \beta_2 TA_{i,t}{*}Vol_i + \beta_3 TA_{i,t}{*}Post_t + \beta_4 TA_{i,t} + \beta_5 CFO_{i,t}{*}Vol_i{*}Post_t + \beta_6 CFO_{i,t}{*}Vol_i + \beta_7 CFO_{i,t}{*}Post_t + \beta_8 CFO_{i,t} + \beta_9\ Vol_i{*}Post_t + fixed\_effects + \varepsilon_{i,t}$								
TA*Vol*Post	0.239** (2.15)	0.240** (2.17)	0.296** (2.21)	0.299** (2.24)	3.497** (2.46)	3.451** (2.45)	3.365***(3.27)	3.336***(3.24)
TA*Vol	−0.086* (−1.90)	−0.089* (−1.94)	−0.112* (−1.74)	−0.116* (−1.80)	−1.449** (−2.34)	−1.452** (−2.36)	−0.950** (−2.26)	−0.971** (−2.31)
TA*Post	0.065 (0.87)	0.061 (0.82)	0.068 (1.15)	0.063 (1.08)	0.022 (0.35)	0.021 (0.33)	0.059 (1.25)	0.057 (1.20)
TA	0.131***(3.03)	0.133***(3.09)	0.130***(4.17)	0.133***(4.26)	0.165***(5.08)	0.166***(5.11)	0.127***(5.06)	0.129***(5.14)
CFO*Vol*Post	−0.042 (−0.30)	−0.040 (−0.29)	−0.096 (−1.00)	−0.092 (−0.96)	1.411 (1.23)	1.399 (1.22)	1.922***(2.63)	1.911***(2.62)
CFO*Vol	−0.059 (−0.60)	−0.059 (−0.61)	0.163***(2.94)	0.162***(2.92)	−1.009 (−1.50)	−0.994 (−1.49)	0.633 (1.62)	0.661* (1.69)
CFO*Post	0.089 (1.42)	0.087 (1.38)	0.136***(3.05)	0.132***(2.97)	0.003 (0.06)	0.002 (0.04)	0.016 (0.43)	0.015 (0.40)
CFO	0.667***(14.09)	0.669***(14.25)	0.226***(7.40)	0.229***(7.52)	0.695***(18.00)	0.696***(18.14)	0.276***(10.59)	0.277***(10.65)
Vol*Post	−0.004 (−0.24)	−0.004 (−0.23)	0.001 (0.07)	0.001 (0.07)	0.021 (0.16)	0.021 (0.15)	−0.084 (−0.81)	−0.084 (−0.81)
Vol	0.017 (1.20)	0.016 (1.17)			0.067 (0.63)	0.065 (0.62)		
Post	−0.007 (−0.97)		−0.017***(−3.23)		−0.005 (−0.98)		−0.011** (−2.43)	
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	47.30%	47.46%	60.00%	60.77%	47.38%	47.54%	60.59%	60.75%
#Obs.	5536	5536	5536	5536	5536	5536	5536	5536

The table provides the industry/firm/year fixed-effect regression results with information availability as dependent variable based on the SOX-reform sample. Information availability is measured as analyst forecast dispersion (*Dispersion*), stock return synchronicity (*Synch*), or cash flow informativeness of accounting accruals in Panel A, Panel B or Panel C, respectively. All variables are defined in Table A1 in the Appendix. T-statistics (in parentheses) are calculated using firm-clustering and heteroscedasticity robust standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

For the variables of interest, the coefficients of *Vol* are significantly positive at least at the 5% level in the industry fixed-effect models, which suggests that the level of information availability is decreasing in performance volatility. The coefficients of *Post* are significantly positive, suggesting that information availability does not improve post the reform for firms with low pre-SOX volatility. The coefficients of *Vol*Post* are significantly negative at least at the 5% level across all regressions, which strongly suggests that high, relative to low, volatility firms experience an increase in information availability post the reform. This difference-in-differences effect is economically significant as well, one standard deviation increase in pre-SOX stock return (ROA) volatility being associated with an additional increase in information availability as measured by *Dispersion* post SOX by 16–25% (17%–24%) of the mean value. In terms of the control variables, the coefficients of *Size* and *ROA* (*EPSchg*) are significantly negative (positive), indicating that firms with larger size and higher accounting profitability (larger absolute changes in earnings per share) tend to have more (less) performance information available to investors, consistent with our expectation. The coefficients of the other variables are insignificant.

Panel B reports the regression results on stock return synchronicity (*Synch*) according to Eq. (1). We include control vari-

ables that can potentially affect a firm's stock return synchronicity following Piotroski and Roulstone (2004). *Size, Divers*, and *Fundcorr* are included to control for the firm's information environment, the degree of business diversification, and the correlation between the firm's fundamental performance and the industry's fundamental performance, respectively. We include variables measuring the industry concentration (*log(Herf)*), the number of firms in the industry (*log(Nind)*), and the correlation between the industry return and the market return (*Retcorr*) to control for potential cross-industry difference in stock return comovement. Moreover, net insider trading intensity (*Instrd*), institutional ownership (*Inst*), and the number of analyst forecast revisions (*Nrev*) are included since concurrent insiders' trading behavior, institutional investors' demand, and analysts' forecast activities can all contribute to the price discovery process.

As we can see, the coefficients on *Vol* and *Post* (*Vol*Post*) are significantly positive (negative), similar to the findings based on *Dispersion*, suggesting that 1) the level of performance information availability is decreasing in pre-SOX volatility in performance, 2) information availability does not improve post SOX for firms with low pre-SOX volatility, and 3) high, relative to low, volatility firms experience a significant increase in information availability post SOX. In terms of economic magnitude, one standard deviation increase in pre-SOX stock return (ROA) volatility is associated with an additional increase in information availability as measured by *Synch* post SOX by 16%−19% (13%−17%) of the mean value. In terms of the control variables, the coefficients of *Retcorr* and *Nrev* (*log(Nind), InsTrd* and *Inst*) are significantly positive (negative), suggesting that firm-specific information availability is lower (higher) for firms with higher industry-market return correlation and more analyst forecast revisions (more industry peers, more insider trading activities and higher institutional ownership), consistent with the extant findings in the literature (Piotroski and Roulstone, 2004). The coefficients of the other variables are either mixed or insignificant.

Panel C presents the regression results on future cash flow informativeness of accounting accruals according to Eq. (3). It is clear that the coefficients of *TA*Vol* are significantly negative, suggesting that performance information availability as proxied by future cash flow informativeness of accruals is decreasing in pre-SOX performance volatility. The coefficients of *TA*Post* are insignificant, indicating no post-SOX improvement in information availability for low volatility firms. The coefficients of *TA*Vol*Post* are significantly positive at least at the 5% level, suggesting that future cash flow informativeness of accruals significantly improves post SOX for firms with high pre-SOX performance volatility relative to firms with low volatility. With regards to economic magnitude, one standard deviation increase in pre-SOX industry-adjusted stock return (ROA) volatility is associated with an increase of 7–10% (10–11%) of the coefficients of *TA* in predicting future cash flow post SOX.

To summarize, our results based on three different measures of information availability strongly suggest that information availability decreases in pre-SOX performance volatility, and high, relative to low, volatility firms experience a significant increase in information availability post SOX. The evidence is in line with the 'managerial evaluation risk' hypothesis and the 'proprietary information' hypothesis.

3.2.2. CEO turnover-to-performance sensitivity

As discussed in the introduction, the 'managerial evaluation risk' hypothesis predicts an additional increase in CEO turnover-to-performance sensitivity post SOX for firms with high, relative to low, performance volatility. Following Parrino (1997), HYPERLINK \l "bib10" Bushman et al. (2010) , Li and Srinivasan (2011) and Jenter and Kanaan (2015), we focus on board-induced forced CEO turnovers and estimate the following difference-in-differences logistic regression model.

$$P_t(Turnover_{i,t+1}=1)=\frac{1}{1+exp(-X_{i,t}\beta)},\ \text{with}$$

$$\begin{aligned}X_{i,t}\beta=\ &\alpha+\beta_1 Vol_i*Post_t*ROA_{i,t}+\beta_2 Post_t*ROA_{i,t}\\&+\beta_3 Vol_i*ROA_{i,t}+\beta_4 ROA_{i,t}+\beta_5 Vol_i*Post_t*RetDif_{i,t}\\&+\beta_6 Post_t*RetDif_{i,t}+\beta_7 Vol_i*RetDif_{i,t}+\beta_8 RetDif_{i,t}\\&+\beta_9 Vol_i*Post_t+\beta_{10} Vol_i+\beta_{11} Post_t+\beta_{12} Size_{i,t}*ROA_{i,t}\\&+\beta_{13} Size_{i,t}*RetDif_{i,t}+\beta_{14} Size_{i,t}+\beta_{15} Lev_{i,t}*ROA_{i,t}\\&+\beta_{16} Lev_{i,t}*RetDif_{i,t}+\beta_{17} Lev_{i,t}+\beta_{18} BM_{i,t}*ROA_{i,t}\\&+\beta_{19} BM_{i,t}*RetDif_{i,t}+\beta_{20} BM_{i,t}+\beta_{21} RetInd_{i,t}*ROA_{i,t}\\&+\beta_{22} RetInd_{i,t}*RetDif_{i,t}+\beta_{23} RetInd_{i,t}+\beta_{24} Age_{i,t}*ROA_{i,t}\\&+\beta_{25} Age_{i,t}*RetDif_{i,t}+\beta_{26} Age_{i,t}+fixed\_effects+\varepsilon_{i,t}.\end{aligned}\tag{4}$$

The dependent variable *Turnover* is a dummy that equals 1 if a CEO is *forced* to leave the position in fiscal year $t+1$, and 0 otherwise. We identify forced turnovers following the steps in Parrino (1997), Li and Srinivasan (2011) and others.[2] Following Li and Srinivasan (2011), Bushman et al. (2010) and others, we use two variables, *ROA* and *RetDif*, to measure firm performance. If the turnover occurs between July and December, *ROA* is the return on assets in fiscal year $t+1$, if between January and June, the return on assets in fiscal year *t*. *RetDif* is industry-adjusted stock returns in the 12 months preceding the turnover date for firm-year observations with forced CEO turnover. These two variables are measured as of fiscal year *t* for firm-year observations without forced CEO turnover. The control variable *RetInd*, median annual returns of firms in the same industry in fiscal year *t*, is included to control for the industry performance (Jenter and Kanaan, 2015). *Age*, a dummy that equals 1 if the CEO is more than 60 years old at the end of fiscal year *t* and 0 otherwise, is included since older CEOs are more likely to retire voluntarily (Peters and Wagner, 2014). Following Parrino (1997), Hazarika et al. (2012) and others, we include *Size, BM*, and *Lev* to control for firm scale, growth opportunities and financial leverage, which might affect turnover decisions. Since our main interest is the heterogeneous impact of SOX on CEO turnover-to-performance sensitivity across firms with different levels of pre-SOX volatility and SOX mainly targets at the quantity and quality of financial performance information, our focus is on the coefficient of the three-way interaction term *Vol*Post*ROA*. We expect the sign of β_1 to be negative if there is an additional increase in CEO turnover-to-performance sensitivity post SOX for firms with high, relative to low, pre-SOX performance volatility.

Table 4 presents the results. Since most of the sample firms have one CEO turnover at the maximum in the sample period, no firm fixed effects, but only industry fixed effects, are controlled for

[2] We first identify CEO turnovers for our sample firms in each year using the Execucomp database; a turnover occurs if the CEO in the next fiscal year *t+1* and CEO in the current fiscal year *t* are not the same person. We then search the Factiva news database to determine whether the turnover is forced or routine based on information in the news announcement. Turnovers are classified as forced if press articles report the CEO being fired, demoted, or resigning under questionable circumstances (e.g., policy differences, pressure, lawsuits, or suspected earnings management). Among routine turnover events, we further classify them as forced turnovers if a CEO retires at an age less than 60 or if the news article does not report the reason as death, poor health, or acceptance of another position. We exclude CEO turnovers due to death, interim appointments, mergers and acquisitions, spinoffs, or if the firm's financial data is missing. Including M&A-induced turnovers does not change our findings. Moreover, we do not find an increase in M&A-induced CEO turnover-to-performance sensitivity post SOX for firms with high, relative to low, volatility likely because M&A are often motivated by factors unrelated to firm performance (e.g., over-valued equity, hubris, technology shocks, deregulations, synergies, etc.).

Table 4
Forced CEO turnover as dependent variable.

$P_t(Turnover_{i,t+1}=1)=\frac{1}{1+\exp(-X_{i,t}\beta)}$, with
$X_{i,t}\beta=\alpha+\beta_1 Vol_i{}^{*}Post_t{}^{*}ROA_{i,t}+\beta_2 Post_t{}^{*}ROA_{i,t}+\beta_3 Vol_i{}^{*}ROA_{i,t}+\beta_4 ROA_{i,t}+\beta_5 Vol_i{}^{*}Post_t{}^{*}RetDif_{i,t}+\beta_6 Post_t{}^{*}RetDif_{i,t}+\beta_7 Vol_i{}^{*}RetDif_{i,t}+\beta_8 RetDif_{i,t}+\beta_9 Vol_i{}^{*}Post_t+\beta_{10} Vol_i+\beta_{11} Post_t+\beta_{12} Size_{i,t}{}^{*}ROA_{i,t}+\beta_{13} Size_{i,t}{}^{*}RetDif_{i,t}+\beta_{14} Size_{i,t}+\beta_{15} Lev_{i,t}{}^{*}ROA_{i,t}+\beta_{16} Lev_{i,t}{}^{*}RetDif_{i,t}+\beta_{17} Lev_{i,t}+\beta_{18} BM_{i,t}{}^{*}ROA_{i,t}+\beta_{19} BM_{i,t}{}^{*}RetDif_{i,t}+\beta_{20} BM_{i,t}+\beta_{21} RetInd_{i,t}{}^{*}ROA_{i,t}+\beta_{22} RetInd_{i,t}{}^{*}RetDif_{i,t}+\beta_{23} RetInd_{i,t}+\beta_{24} Age_{i,t}{}^{*}ROA_{i,t}+\beta_{25} Age_{i,t}{}^{*}RetDif_{i,t}+\beta_{26} Age_{i,t}+\text{fixed\_effects}+\varepsilon_{i,t}$

Variable	Vol = Vol_RET		Vol = Vol_ROA	
	(1)	(2)	(3)	(4)
Vol*Post*ROA	−0.723**	−0.682**	−6.724***	−7.390***
	(−2.26)	(−2.25)	(−3.08)	(−3.11)
Post*ROA	0.328	0.375	2.075	2.104
	(0.20)	(0.23)	(1.16)	(1.16)
Vol*ROA	−0.225	−0.361	28.247***	28.433***
	(−0.19)	(−0.30)	(2.77)	(2.79)
ROA	−1.230**	−1.029**	−4.520**	−4.426**
	(−2.42)	(−2.34)	(−2.39)	(−2.35)
Vol*Post*RetDif	−0.258	−0.164	−2.559	−2.447
	(−0.45)	(−0.29)	(−0.72)	(−0.70)
Post*RetDif	0.235	0.137	0.214	0.161
	(0.64)	(0.37)	(0.74)	(0.56)
Vol*RetDif	−0.155	−0.211	0.909	0.965
	(−0.41)	(−0.57)	(0.45)	(0.51)
RetDif	−0.661**	−0.532*	−0.958***	−0.876**
	(−2.10)	(−1.90)	(−2.61)	(−2.53)
Vol*Post	−0.334	−0.272	−3.867*	−3.978*
	(−1.24)	(−1.00)	(−1.85)	(−1.89)
Vol	0.356	0.289	4.144***	4.365***
	(1.58)	(1.29)	(2.91)	(3.03)
Post	0.287**		0.238*	
	(2.06)		(1.77)	
Size*ROA	0.001	0.005	0.119	0.124
	(0.01)	(0.02)	(0.32)	(0.33)
Size*RetDif	0.006	−0.001	0.020	0.015
	(0.07)	(−0.01)	(0.24)	(0.18)
Size	0.016	0.011	0.009	0.007
	(0.44)	(0.30)	(0.25)	(0.20)
Lev*ROA	1.730	1.492	2.126	2.002
	(0.70)	(0.61)	(0.89)	(0.85)
Lev*RetDif	0.059	0.082	0.162	0.167
	(0.13)	(0.18)	(0.36)	(0.39)
Lev	0.469*	0.480*	0.397*	0.400*
	(1.87)	(1.91)	(1.70)	(1.72)
BM*ROA	0.264	0.257	−1.196	−1.156
	(0.18)	(0.18)	(−0.96)	(−0.92)
BM*RetDif	0.887***	0.879***	1.001***	1.009***
	(3.12)	(3.14)	(3.51)	(3.59)
BM	0.025	0.074	−0.019	0.031
	(0.16)	(0.48)	(−0.12)	(0.20)
RetInd*ROA	−2.337	−2.338	−3.092*	−3.159*
	(−1.24)	(−1.22)	(−1.69)	(−1.70)
RetInd*RetDif	−0.000	−0.007	−0.061	−0.073
	(−0.02)	(−0.02)	(−0.21)	(−0.25)
RetInd	−0.006	−0.111	0.003	−0.132
	(−0.03)	(−0.48)	(0.01)	(−0.57)
Age*ROA	−0.969	−0.973	−0.515	−0.559
	(−0.69)	(−0.68)	(−0.38)	(−0.41)
Age*RetDif	0.211	0.201	0.244	0.231
	(1.06)	(1.03)	(1.27)	(1.27)
Age	−0.300***	−0.315***	−0.314***	−0.326***
	(−2.94)	(−3.06)	(−3.17)	(−3.28)
Intercept	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Ind.	Ind./Year
Pseudo R^2	7.12%	7.89%	8.32%	9.18%
#Obs.	7259	7259	7259	7259

The table provides the logistic regression results with *Turnover* as dependent variable based on the SOX-reform sample. Industry fixed effects or industry and year fixed effects are controlled for in the regressions. All variables are defined in Table A1 in the Appendix. Z-statistics (in parentheses) are calculated using firm-clustering and heteroscedasticity robust standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

in the logistic regressions. Z-statistics (in parentheses) are calculated with firm-clustering and heteroscedasticity robust standard errors. The control variables generally show expected signs. For example, the coefficients of the two performance measures, *ROA* and *RetDif*, are significantly negative across all models, suggesting that better-performing CEOs are less likely to be fired. The coefficients of *Age* are significantly negative, suggesting that older CEOs are more likely to retire voluntarily. The coefficients of *Lev* are significantly positive, suggesting that CEOs of highly levered firms are more likely to be fired. The coefficients of *BM*RetDif* are signifi-

cantly positive, implying that forced turnover is less sensitive to relative stock return performance for value, than for growth, firms.

The coefficients of *Post*ROA* are insignificant in all models, suggesting no significant change in turnover-to-performance sensitivity post SOX for firms with low pre-SOX performance volatility. Consistent with our expectation of a heterogeneous impact of SOX on CEO turnover-to-performance sensitivity for firms with high, relative to low, performance volatility, the coefficients of *Vol*Post*ROA* are significantly negative at least at the 5% level across all models. To interpret the economic magnitude of the difference-in-differences effect, we follow Norton et al. (2004) and Corneliben and Sonderhof (2009) in calculating the marginal effects of *Vol*Post*ROA*, which are −0.082, −0.078, −0.714 and −0.778 for Models 1–4 of Table 4, respectively.[3] That is, when ROA shifts from the 90th to the 10th percentile, a drop of 13%, one standard deviation increase in pre-SOX industry-adjust stock return (ROA) volatility is associated with an additional increase of 0.33–0.35% (0.30–0.32%) in the probability of forced CEO turnover post SOX. This magnitude is economically substantial: given that the unconditional forced turnover rate is about 4% in the sample,[4] it amounts to 8–9% (7–8%) of the unconditional forced turnover rate. Thus, the evidence confirms an additional increase in CEO turnover-to-performance sensitivity post SOX for firms with high, relative to low, pre-SOX performance volatility, lending strong support to the 'managerial evaluation risk' hypothesis.

3.2.3. Myopic behavior

The 'managerial evaluation risk' hypothesis predicts that, in response to the increased performance-driven managerial turnover risk post SOX, managers of high, relative to low, volatility firms will become more myopic and cut R&D expenses to boost short-term performance. R&D expenses are arguably the most important area to examine managerial myopic behavior because such expenses benefit the firm by enhancing its competitiveness in the long term but reduce its short-run profitability. The 'proprietary information' hypothesis similarly predicts that high, relative to low, volatility firms will cut investment in R&D projects post SOX since proprietary knowledge and production information generated by R&D are easier to be leaked to competitors after the mandated increase in information availability. We hence examine the heterogeneous impact of SOX on R&D expenses of high, relative to low, volatility firms according to Eq. (1).

Table 5 presents the results. The dependent variable, *R&D*, is R&D expenses as a ratio of beginning total assets. Following the literature (e.g., Bargeron et al., 2010; Cohen et al., 2013), we include *Size, ROA, SG*, and *Lev* as controls since R&D expenses are likely to be higher (lower) for firms that are larger, more profitable, and/or have greater growth potential (firms that have greater debt burden). As we can see, the control variables are generally significant and have the expected signs. In terms of the variables of interest, the coefficients of *Vol* are positive, suggesting that R&D tends to increase with pre-SOX performance volatility. The coefficients of *Post* are mixed, indicating no obvious post-SOX change in R&D for low volatility firms. The coefficients of *Vol*Post* are negative and statistically significant at the 1% level across all models. One standard deviation increase in pre-SOX industry-adjusted stock return (ROA) volatility is associated with an additional post-SOX reduction in R&D expenses which amounts to 23–30% (14–24%) of the

Table 5
R&D expenses as dependent variable.

$R\&D_{i,t} = \alpha + \beta_1 Vol_i{*}Post_t + \beta_2 Vol_i + \beta_3 Post_t + \beta_4 Size_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 SG_{i,t-1} + \beta_7 ROA_{i,t-1} + fixed\_effects + \varepsilon_{i,t}$

Variable	Vol = Vol_RET				Vol = Vol_ROA			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Vol*Post	−0.038***(−5.95)	−0.040***(−6.07)	−0.031***(−11.57)	−0.033***(−11.96)	−0.194***(−2.70)	−0.196***(−2.73)	−0.323***(−14.55)	−0.325***(−14.62)
Vol	0.026***(2.79)	0.027***(2.94)			0.366***(4.91)	0.367***(4.93)		
Post	0.002 (1.16)		0.004***(3.85)		−0.004* (−1.77)		0.005***(4.55)	
Size	0.002***(3.12)	0.002***(3.35)	−0.005***(−7.89)	−0.004***(−5.42)	0.002***(2.66)	0.002***(2.84)	−0.006***(−9.19)	−0.005***(−7.12)
Lev	−0.050***(−6.01)	−0.050***(−5.99)	−0.009** (−2.47)	−0.007* (−1.88)	−0.042***(−5.38)	−0.042***(−5.37)	−0.003 (−0.73)	−0.001 (−0.30)
SG	0.006** (2.46)	0.006** (2.45)	0.002** (2.37)	0.002** (2.11)	0.008** (2.26)	0.009** (2.32)	0.004** (2.29)	0.004** (2.16)
ROA	−0.050* (−1.91)	−0.051* (−1.96)	0.032***(4.07)	0.028***(3.58)	−0.022 (−0.91)	−0.024 (−0.97)	0.045***(5.74)	0.042***(5.39)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Industry	Ind./Year	Firm	Firm/Year	Industry	Ind./Year	Firm	Firm/Year
Adj. R^2	42.82%	42.98%	77.11%	77.18%	44.42%	44.53%	77.30%	77.43%
#Obs.	7259	7259	7259	7259	7259	7259	7259	7259

The table provides the industry/firm/year fixed-effect regression results with R&D expenses (*R&D*) as dependent variable based on the SOX-reform sample. All variables are defined in Table A1 in the Appendix. T-statistics (in parentheses) are calculated using firm-clustering and heteroscedasticity robust standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

[3] We also follow Angrist and Pischke (2009) and run OLS regressions to obtain the approximate marginal effects of *Vol*Post*ROA, which are -0.087, -0.083, -0.826 and -0.859 for Models 1-4, respectively. Thus, the economic magnitude of the difference-in-differences effect based on OLS regressions is slightly larger than that based on logistic regressions.

[4] Such a low unconditional forced turnover rate is comparable to other studies. For example, the unconditional forced turnover rate in Jenter and Kanaan (2015) is about 3%.

average R&D expenses in the sample. These results support both the 'managerial evaluation risk' hypothesis and the 'proprietary information' hypothesis.[5]

3.2.4. CEO compensation

The 'managerial evaluation risk' hypothesis predicts that managers of high, relative to low, volatility firms will demand higher compensation with a structure tilted towards more cash pay in response to the increased performance-driven managerial turnover risk post SOX. The 'managerial effort' hypothesis also predicts that high, relative to low, volatility firms may demand higher compensation due to the increased levels of productive (but personally costly) effort as a result of greater information availability post SOX. Panels A, B and C of Table 6 present the results for CEO total compensation, cash pay, and equity pay according to regression Eq. (1), respectively.

Pay (in percentage) is CEO total compensation (the sum of salary, bonus, option awards, stock awards, non-equity incentive compensation, changes in pension, and other compensation) scaled by annual sales. Mirroring the 'compensation ratio' in practice, this measure reflects the fraction of the firm's sales revenue paid as CEO compensation and captures the relative level of CEO pay (e.g., Benoit, 2013). Similarly, *Cash Pay* (in percentage) is CEO total cash compensation (the sum of salary, bonus, non-equity incentive compensation, changes in pension, and other compensation) and *Equity Pay* (in percentage) is CEO total equity-related compensation (the sum of option awards and stock awards), both scaled by annual sales. We control for *Size, ROA, Lev, SG* and *RetDif* since CEO compensation (relative to sales revenue) is likely higher for firms that are smaller, more profitable, have lower debt burden, higher growth potential, and better stock performance relative to industry peers (see Murphy (1999) for a survey).

Panel A shows that the coefficients of *Size, Lev* and *RetDif* are significant and have the expected signs while those of the other control variables are either mixed or insignificant. For the variables of interest, the coefficients of *Vol* are significantly positive, suggesting that CEOs in higher volatility firms get greater pay; the coefficients of *Post* are positive and significant, suggesting that CEO compensation increases post SOX even for low volatility firms. Importantly, the coefficients of *Vol*Post* are positive and statistically significant at least at the 5% level across all models, confirming that high, relative to low, volatility firms experience greater increase in CEO compensation post SOX. One standard deviation increase in pre-SOX industry-adjusted stock return (ROA) volatility is associated with an additional post-SOX increase in CEO compensation which amounts to 11–14% (7–15%) of the average CEO total compensation. Panels B and C show that the increase in CEO pay for high, relative to low, volatility firms post SOX comes entirely from cash pay and not from equity pay.

Overall, the evidence strongly suggests that managers of high, relative to low, volatility firms receive higher compensation with a flatter structure tilted towards more cash pay post SOX, which supports the 'managerial evaluation risk' hypothesis. It is also potentially consistent with the 'managerial effort' hypothesis.

[5] An alternative explanation for these findings is that firms substitute accruals-based earnings management with real earnings management such as cutting R&D post SOX (Cohen, Dey, and Lys, 2008). Such an explanation is inconsistent with our finding on the post-SOX changes in CEO turnover-to-performance sensitivity, however. Under the alternative explanation, the total amount of (real and accruals-based) earnings management in reported earnings does not change and hence the informativeness of reported earnings on the firm's true profitability does not change for high versus low volatility firms post SOX. Thus, turnover-to-performance sensitivity should remain unchanged post SOX for high versus low volatility firms under this alternative explanation.

3.2.5. Firm valuation

As discussed earlier, both the 'managerial evaluation risk' and 'proprietary information' hypotheses predict that firms with high, relative to low, performance volatility experience a reduction in firm value post SOX. In contrast, the 'managerial effort' hypothesis predicts an increase in firm value for high, relative to low, volatility firms. To test these hypotheses, we run difference-in-differences regressions based on Eq. (1) with Tobin's Q as the measure of firm value. We control for firm size, leverage and asset growth given that the literature suggests these firm characteristics are related to firm value (e.g., Daske et al., 2008). Table 7 presents the results. The control variables are generally significant and suggest that larger firms, lower leveraged firms and firms with higher asset growth tend to have higher firm value.

For the variables of interest, the coefficients of *Vol* are significantly positive, suggesting that firms with higher volatility have higher firm value. The coefficients of *Post* are mostly significantly negative, indicating a post-SOX reduction in firm value even for low volatility firms. More importantly, the coefficients of *Vol*Post* are significantly negative at the 1% level across all models. One standard deviation increase in pre-SOX industry-adjusted stock return (ROA) volatility is associated with an additional reduction in *Q* by 18–19% (12–14%) of the average Tobin's Q. The results are consistent with both the 'managerial evaluation risk' hypothesis and the 'proprietary information' hypothesis but contradict the 'managerial effort' hypothesis.

To summarize, this section documents heterogeneous impact of SOX on performance information availability, CEO turnover-to-performance sensitivity, R&D expenses, managerial compensation, and firm value for high versus low volatility firms, which is consistent with the 'managerial evaluation risk' hypothesis. The findings on information availability, R&D expenses and firm value can be potentially explained by the 'proprietary information' hypothesis, which, however, does not provide any prediction on CEO turnover-to-performance sensitivity and managerial compensation. The evidence on managerial compensation is in line with, but that on firm value contradicts, the 'managerial effort' hypothesis.

4. Evidence from the mandatory quarterly reporting reform in 1970

To ensure that our findings are generalizable beyond the SOX reform, we perform a robustness check using data from the regulation on quarterly reporting mandated by the SEC in 1970. The New York Stock Exchange (NYSE) had as early as 1923 begun to require quarterly reporting by most newly listed firms, and the American Stock Exchange (AMEX) required quarterly reporting for newly listed firms beginning in 1962. The SEC required annual financial reporting in 1934 and raised the required reporting frequency to semi-annual level in 1955. Not until 1970 did the SEC mandate quarterly reporting. Firms reporting semiannually have been forced to increase their reporting frequency to quarterly level since 1970, which provides us another opportunity to test the hypotheses.

Compared with semiannual reporting, quarterly reporting provides new performance information to investors besides timely release of information. First, performance information not available in aggregated semiannual or annual reports, such as the reasons for changes in sales by segment or region over the last quarter or same quarter of the last year, can help investors better understand firm financial performance. Second, trends in performance, which are important to investor decision making, are better inferred from four than from two performance indicators (e.g., a decline in earnings in a single quarter might be due to a one-time shock; a steady decline in quarterly earnings suggests longer-term concerns). Third, requiring universal quarterly reporting increases the comparability between firms that had to increase their reporting frequency and

Table 6
CEO compensation as dependent variable.

$$Pay_{i,t} = \alpha + \beta_1 Vol_i{}^{*}Post_t + \beta_2 Vol_i + \beta_3 Post_t + \beta_4 Size_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 SG_{i,t-1} + \beta_7 ROA_{i,t-1} + \beta_8 RetDif_{i,t-1} + fixed\_effects + \varepsilon_{i,t}$$

Variable	Vol = Vol_RET				Vol = Vol_ROA			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Total compensation (Pay) as dependent variable								
Vol*Post	0.056** (2.17)	0.051** (2.04)	0.047** (2.68)	0.049** (2.28)	0.588***(2.63)	0.605***(2.70)	0.285***(3.06)	0.317***(3.59)
Vol	0.079** (2.41)	0.072** (2.17)			0.482***(2.66)	0.466***(2.60)		
Post	0.090***(12.15)		0.079***(16.36)		0.073***(10.36)		0.068***(15.36)	
Size	−0.043***(−16.02)	−0.044***(−16.14)	−0.033***(−12.88)	−0.044***(−15.88)	−0.045***(−17.40)	−0.046***(−17.50)	−0.033***(−13.10)	−0.044***(−16.15)
Lev	−0.174***(−5.26)	−0.174***(−5.28)	−0.087***(−5.68)	−0.101***(−6.81)	−0.171***(−5.03)	−0.170***(−5.05)	−0.090***(−5.84)	−0.105***(−7.08)
SG	−0.010 (−0.62)	−0.004 (−0.25)	−0.044***(−6.19)	−0.032***(−4.71)	−0.001 (−0.10)	0.003 (0.22)	−0.042***(−6.01)	−0.031***(−4.62)
ROA	−0.163 (−1.44)	−0.171 (−1.52)	0.048 (1.52)	0.052* (1.71)	−0.132 (−1.21)	−0.139 (−1.29)	0.043 (1.37)	0.045 (1.49)
RetDif	0.020***(3.15)	0.019***(3.04)	0.010***(2.74)	0.010***(2.67)	0.020***(3.28)	0.019***(3.17)	0.011***(2.77)	0.010***(2.69)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	34.55%	37.69%	71.82%	74.71%	35.01%	38.22%	71.87%	74.78%
#Obs.	7259	7259	7259	7259	7259	7259	7259	7259
Panel B: Cash Pay as dependent variable								
Vol*Post	0.064***(5.23)	0.057***(4.73)	0.055***(8.06)	0.056***(8.14)	0.637***(6.40)	0.645***(6.50)	0.624***(13.39)	0.640***(15.64)
Vol	−0.007***(−2.71)	−0.008***(−3.28)			−0.059***(−3.35)	−0.067***(−3.79)		
Post	0.037***(10.78)		0.032***(13.06)		0.031***(10.10)		0.027***(12.21)	
Size	−0.002***(−4.71)	−0.003***(−6.04)	0.002* (1.73)	−0.002* (−1.73)	−0.002***(−4.35)	−0.003***(−5.52)	0.003** (2.42)	−0.001 (−0.70)
Lev	−0.004 (−0.78)	−0.004 (−0.74)	0.011 (1.38)	0.007 (1.02)	−0.006 (−1.20)	−0.006 (−1.16)	−0.001 (−0.10)	−0.004 (−0.62)
SG	−0.009***(−3.03)	−0.004 (−1.64)	−0.015***(−4.11)	−0.007** (−2.32)	−0.011***(−3.79)	−0.007** (−2.53)	−0.016***(−4.63)	−0.009***(−3.02)
ROA	−0.012 (−0.70)	−0.021 (−1.27)	0.016 (1.02)	0.008 (0.53)	−0.014 (−0.83)	−0.023 (−1.44)	−0.003 (−0.20)	−0.014 (−1.00)
RetDif	0.003* (1.67)	0.002 (1.14)	0.001 (0.48)	−0.000 (−0.03)	0.003 (1.55)	0.002 (0.96)	0.001 (0.37)	−0.000 (−0.21)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	21.63%	37.62%	32.13%	47.60%	23.54%	39.51%	33.48%	48.91%
#Obs.	7259	7259	7259	7259	7259	7259	7259	7259
Panel C: Equity Pay as dependent variable								
Vol*Post	−0.009 (−0.16)	−0.006 (−0.11)	−0.009(−0.16)	−0.008(−0.14)	−0.065 (−0.36)	−0.057 (−0.32)	−0.291***(−4.29)	−0.277***(−4.11)
Vol	0.082***(3.16)	0.079***(2.98)			0.483***(2.95)	0.476***(2.92)		
Post	0.053***(9.12)		0.047***(12.68)		0.040***(7.10)		0.037***(11.45)	
Size	−0.041***(−16.77)	−0.041***(−16.68)	−0.034***(−18.48)	−0.040***(−19.07)	−0.043***(−18.23)	−0.043***(−18.13)	−0.035***(−19.00)	−0.041***(−19.78)
Lev	−0.153***(−5.73)	−0.153***(−5.73)	−0.081***(−7.25)	−0.090***(−7.99)	−0.149***(−5.38)	−0.148***(−5.38)	−0.073***(−6.50)	−0.083***(−7.37)
SG	−0.007 (−0.50)	−0.006 (−0.41)	−0.030***(−5.91)	−0.026***(−5.12)	0.002 (0.19)	0.003 (0.22)	−0.028***(−5.44)	−0.024***(−4.68)
ROA	−0.083 (−0.94)	−0.082 (−0.92)	0.038 (1.64)	0.050** (2.15)	−0.054 (−0.63)	−0.052 (−0.60)	0.053** (2.29)	0.065***(2.80)
RetDif	0.017***(3.35)	0.017***(3.37)	0.011***(3.94)	0.011***(4.03)	0.017***(3.50)	0.017***(3.52)	0.011***(4.07)	0.012***(4.16)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	37.48%	37.79%	78.40%	78.67%	37.35%	37.73%	78.30%	78.62%
#Obs.	7259	7259	7259	7259	7259	7259	7259	7259

The table provides the industry/firm/year fixed-effect regression results with CEO compensation as dependent variable based on the SOX-reform sample.CEO compensation is measured as CEO total compensation (*Pay*), CEO cash compensation (*Cash Pay*), or CEO equity compensation (*Equity Pay*) in Panel A, Panel B or Panel C, respectively. All variables are defined in Table A1 in the Appendix. T-statistics (in parentheses) are calculated using firm-clustering and heteroscedasticity robust standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7
Tobin's Q as dependent variable.

$Q_{i,t} = \alpha + \beta_1 Vol_i{*}Post_t + \beta_2 Vol_i + \beta_3 Post_t + \beta_4 Size_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 AG_{i,t-1} + fixed\_effects + \varepsilon_{i,t}$

Variable	Vol = Vol_RET				Vol = Vol_ROA			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Vol*Post	−1.146***(−6.40)	−1.117***(−6.23)	−1.147***(−15.09)	−1.155***(−15.15)	−8.086*** (−7.65)	−8.033*** (−7.26)	−8.940***(−7.71)	−8.972***(−7.79)
Vol	1.222***(6.52)	1.189***(6.34)			3.878***(2.61)	3.827***(2.59)		
Post	0.055 (0.93)		−0.086***(−2.61)		−0.191***(−3.20)		−0.291***(−9.61)	
Size	0.255***(12.24)	0.256***(12.18)	0.306***(17.57)	0.323***(16.55)	0.229***(11.34)	0.230***(11.30)	0.283***(16.15)	0.287***(14.66)
Lev	−2.442***(−12.38)	−2.459***(−12.46)	−0.459***(−4.46)	−0.445***(−4.23)	−2.458***(−11.96)	−2.476***(−12.06)	−0.339***(−3.25)	−0.356***(−3.35)
AG	0.288***(3.73)	0.284***(3.71)	−0.037 (−0.91)	−0.041 (−1.00)	0.416***(5.26)	0.404***(5.14)	0.029 (0.70)	0.030 (0.73)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	36.56%	36.95%	69.63%	69.95%	34.60%	35.13%	68.84%	69.17%
#Obs.	7259	7259	7259	7259	7259	7259	7259	7259

The table provides the industry/firm/year fixed-effect regression results with Tobin's Q value (Q) as dependent variable based on the SOX-reform sample. All variables are defined in Table A1 in the Appendix. T-statistics (in parentheses) are calculated using firm-clustering and heteroscedasticity robust standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

those that had been reporting quarterly pre regulation, allowing investors to better evaluate managerial performance relative to peer firms.

The sample for the 1970 reform is drawn from the CRSP-Compustat universe with non-missing interim reporting frequency data, which are hand-collected from *Moody's Industrial News Reports*. The sample firms include those that are forced to increase interim reporting frequency from semiannual to quarterly level around 1970. The sample period of this second reform, like that of the SOX reform, encompasses two subperiods, the pre-reform period from 1960 to 1967, and post-reform period from 1971 to 1975. The transitioning period of 1968–1970, being occupied by the SEC discussions and proposals regarding the mandating of quarterly reporting, is excluded from the analysis. The results nevertheless hold when we include this period in the sample and reclassify the pre-reform period to be 1960–1969 and the post-reform period to be 1970–1975. The following two sample selection criteria are enforced: (1) all firm-year observations should have sufficient CRSP/Compustat/reporting frequency data, and (2) a firm should have at least one year of valid observation (with non-missing data for all variables) in the pre-reform period and one year of valid observation in the post-reform period. The final sample consists of 108 unique firms that are forced to increase their reporting frequency and 835 firm-year observations.

Data needed to analyze the effect on analyst forecast dispersion, future cash flow informativeness of accounting accruals, CEO turnover-to-performance sensitivity and CEO compensation are unavailable in that period (cash flow statement data and analyst forecast data are available since 1980s; Execucomp data is available only since 1990s). Thus, we focus our analysis on stock return synchronicity, R&D expenses, and Tobin's Q. We winsorize all variables without natural bounds at the 1 and 99 percentiles; the results are again insensitive to winsorization.

Panel B of Table 1 provides the summary statistics for the 1970-reform sample and columns 3–4 of Table 2 provide the results from OLS regressions that examine the determinants of pre-reform performance volatility.[6] Similar to the finding in the SOX sample, the evidence suggests that smaller and younger firms have higher industry-adjusted stock return and ROA volatilities. In contrast to the finding in the SOX sample, we do not find a significant relation between R&D intensity and performance volatility in the 1970-reform sample.

Table 8 presents the results on the heterogeneous impact of the 1970 reform on firms with different levels of pre-reform performance volatility. The regression specifications are the same as those used in the SOX setting. Panel A reports the result on information availability as measured by stock return synchronicity. The coefficients of *Vol* are significantly positive at the 1% level in all models, strongly suggesting that higher volatility firms have lower levels of information availability. The coefficients of *Post* are significantly positive at the 1% level, suggesting that information availability does not increase post the reform for firms with low volatility. The coefficients of the difference-in-differences term, *Vol***Post*, are significantly negative at the 1% level across all models, suggesting that firms with high, relative to low, pre-reform performance volatility experience a significant reduction in stock return synchronicity and hence a significant increase in information availability post the reform. One standard deviation increase in pre-reform industry-adjusted stock return (ROA) volatility is associated with an additional increase in information availability post the reform by 18–23% (18–24%) of the mean synchronicity in the 1970-reform sample.

[6] *Divers* is excluded from the model due to the unavailability of segment data in Compustat during that period.

Table 8
Regression results for the 1970-reform sample.

Variable	Vol = *Vol_RET*				Vol = *Vol_ROA*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Stock return synchronicity(*Synch*)as dependent variable								
Vol*Post	−0.230***(−3.59)	−0.231***(−4.01)	−0.187***(−3.32)	−0.210***(−4.16)	−2.046***(−3.75)	−2.545***(−5.02)	−2.240***(−3.77)	−2.672***(−4.94)
Vol	0.229***(3.66)	0.228***(3.99)			2.102***(3.81)	2.478***(4.85)		
Post	0.102***(5.16)		0.140***(6.87)		0.062***(3.85)		0.113***(6.59)	
Size	0.093***(19.94)	0.093***(20.79)	0.028** (2.27)	0.036***(3.23)	0.087***(23.44)	0.087***(24.38)	0.026***(2.80)	0.024***(2.71)
Fundcorr	0.001 (1.12)	0.003***(2.91)	−0.000 (−0.16)	0.002 (1.43)	−0.001 (−0.89)	0.001 (0.90)	−0.001 (−1.01)	0.000 (0.27)
log(Herf)	0.151***(7.99)	0.073***(3.11)	0.137***(6.48)	0.103***(4.36)	0.140***(8.94)	0.051***(2.69)	0.127***(7.38)	0.080***(4.15)
log(Nind)	0.228***(8.69)	0.094***(2.98)	0.214***(9.12)	0.071***(2.73)	0.232***(11.07)	0.081***(3.03)	0.223***(12.08)	0.051** (2.35)
Retcorr	−0.271***(−4.70)	−0.183***(−2.59)	−0.303***(−4.67)	−0.195***(−2.75)	−0.213***(−4.54)	−0.136** (−2.41)	−0.205***(−3.90)	−0.117** (−2.03)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	23.02%	36.30%	45.88%	57.90%	22.33%	33.22%	50.34%	60.26%
#obs	835	835	835	835	835	835	835	835
Panel B: R&Dexpenses (*R&D*)as dependent variable								
Vol*Post	−0.004***(−2.63)	−0.004** (−2.48)	−0.003** (−2.42)	−0.003** (−2.32)	−0.047** (−2.20)	−0.046** (−2.18)	−0.043** (−2.21)	−0.041** (−2.06)
Vol	0.002 (1.25)	0.002 (1.24)			0.093** (2.32)	0.093** (2.30)		
Post	0.008***(8.43)		0.007***(13.80)		0.006***(7.09)		0.006***(15.91)	
Size	0.002***(4.99)	0.002***(5.00)	0.001* (1.65)	0.001* (1.88)	0.001***(5.79)	0.001***(5.75)	0.000 (1.49)	0.000 (1.07)
Lev	−0.007** (−2.24)	−0.008** (−2.23)	−0.002 (−1.07)	−0.004* (−1.75)	−0.013***(−6.85)	−0.013***(−6.64)	−0.004** (−2.40)	−0.005***(−3.46)
SG	0.000 (0.04)	0.000 (0.27)	0.001 (0.92)	0.001 (1.19)	0.000 (0.16)	0.000 (0.49)	0.001 (1.29)	0.001** (1.98)
ROA	0.015 (1.25)	0.015 (1.21)	−0.012* (−1.88)	−0.013** (−2.08)	0.006 (0.69)	0.005 (0.63)	−0.008** (−1.97)	−0.009** (−2.11)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	19.88%	20.18%	63.49%	63.80%	19.49%	19.88%	70.56%	70.84%
#obs	835	835	835	835	835	835	835	835
Panel C: Tobin's Q (*Q*)as dependent variable								
Vol*Post	−0.288** (−2.45)	−0.259** (−2.19)	−0.351***(−8.17)	−0.307***(−7.50)	−3.946***(−14.34)	−3.026***(−12.40)	−3.588***(−12.77)	−3.502***(−13.64)
Vol	0.475***(3.59)	0.436***(3.29)			11.126***(6.71)	11.081***(6.70)		
Post	−0.190***(−5.13)		−0.287***(−15.18)		−0.040 (−1.18)		−0.240***(−15.02)	
Size	0.153***(10.37)	0.148***(10.11)	0.246***(19.39)	0.214***(17.01)	0.163***(16.20)	0.158***(15.70)	0.206***21.58)	0.161***(17.34)
Lev	−0.540***(−4.08)	−0.544***(−4.08)	0.020 (0.25)	0.113 (1.54)	−0.977***(−11.65)	−0.966***(−11.44)	0.064 (1.01)	0.225***(3.82)
AG	0.298***(5.48)	0.331***(5.88)	−0.027 (−0.92)	0.027 (0.95)	0.456***(10.12)	0.494***(10.58)	−0.001 (−0.05)	0.059***(2.82)
Intercept	Included	Included	Included	Included	Included	Included	Included	Included
Fixed Effects	Ind.	Ind./Year	Firm	Firm/Year	Ind.	Ind./Year	Firm	Firm/Year
Adj. R^2	30.18%	33.45%	75.40%	78.38%	25.80%	29.35%	74.76%	78.60%
#obs	835	835	835	835	835	835	835	835

The table reports the regression results for the 1970-reform sample with 835 firm-year observations. Panel A (Panel B, Panel C) provides the regression results with stock return synchronicity (R&D expenses, Tobin's Q) as dependent variable. All variables are defined in Table A1 in the Appendix. T-statistics (in parentheses) are calculated using firm-clustering and heteroscedasticity robust standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel B reports the result on R&D expenses. The coefficients of *Vol* are positive in all and significant in two out of four models, indicating higher R&D expenses for firms with higher pre-reform performance volatility. The coefficients of *Post* are significantly positive at the 1% level, suggesting an increase in R&D expenses for low volatility firms. The coefficients of the difference-in-differences term *Vol*Post* are again significantly negative at least at the 5% level across all models, suggesting that firms with high, relative to low, volatility experience a post-reform reduction in R&D expenses. One standard deviation increase in pre-reform industry-adjusted stock return (ROA) volatility is related to a reduction in R&D expenses post the reform which amounts to 10–14% (12–15%) of the mean R&D expenses in the 1970-reform sample.

The Tobin's Q regression results are in Panel C. As we can see, the coefficients of *Vol* are significantly positive at the 1% level, suggesting higher firm value for higher volatility firms. The coefficients of *Post* are significantly negative at the 1% level, indicating a reduction in firm value post the reform for low volatility firms. The coefficients of *Vol*Post* are significantly negative at least at the 5% level across all models, suggesting that high, relative to low, volatility firms experience an additional reduction in firm value post the reform. One standard deviation increase in pre-reform industry-adjusted stock return (ROA) volatility is associated with an additional post-reform reduction in *Q* which amounts to 6–9% (7–9%) of the mean Tobin's Q value in the 1970-reform sample.

Overall, the additional evidence from the 1970 reform is consistent with the main findings from the SOX reform, strengthening the support for the 'managerial evaluation risk' hypothesis. This evidence is also potentially consistent with the 'proprietary information' hypothesis but contradicts the 'managerial effort' hypothesis.

5. Additional robustness results

In our main results, we apply Fama-French 48 industry classification to compute industry-adjusted stock return or ROA volatility. One potential concern is that the main findings could be sensitive to different industry adjustments. To check this, we recalculate volatility 1) using two-digit-SIC industry classification and 2) without industry adjustment. These results are tabulated in Table A2 in the Appendix, which clearly show that the main findings of the paper are insensitive to alternative industry adjustments.

Another concern for our findings is that they may be driven by pre-existing heterogeneous trends of high versus low volatility firms prior to a reform rather than by the reform itself. Following Roberts and Whited (2013), we check whether the results are similar (for both the SOX- and 1970-reform settings) when only the pre-reform sample period is used in pseudo-event tests, with the pseudo reform being falsely assumed to occur in the middle of that period. If the findings are driven by pre-existing heterogeneous trends, we will expect to see largely similar results. Table A3 in the Appendix shows that none of the main results is statistically significant in the pseudo-event tests.

Yet another concern is that since firms with high volatility are more likely to be young firms, they may mature gradually over time, which then results in a decline in volatility, R&D expenses and Tobin's Q of these firms relative to mature firms with low volatility, even without a reform. To investigate this alternative explanation, we follow Miller and Friesen (1984) in defining mature firms as those aged over 20 years and excluding young firms (which are firms that are less than 20 years old at the beginning of the SOX-reform or 1970-reform sample period according to their first CRSP appearances) from the SOX- and 1970-reform samples, respectively. If this alternative story explains our findings, excluding young firms should substantially weaken the results. Panel A of Table A4 clearly shows that the main results remain qualitatively unchanged even when we exclude young firms from both samples.

In the precious sections, we show that the 'proprietary information' hypothesis likely explains some of our findings. To investigate further whether the 'proprietary information' hypothesis can be the main driver of our findings, we partition both the SOX- and the 1970-reform samples according to their median R&D expenses in the pre-reform periods and rerun the regressions based only on the below-median-R&D firms. Low-R&D firms likely generate less firm-specific proprietary knowledge than do high-R&D firms. If the 'proprietary information' hypothesis is the main driver, we expect that the results will be much weaker in the below-median-R&D subsamples. Panel B of Table A4 shows that our main findings continue to hold in both below-median-R&D subsamples, suggesting that the 'proprietary information' hypothesis is unlikely to be the main driver of our findings.

Finally, another potential concern is that confounding events such as the Internet bubble and NASDAQ crash, which occurred at roughly the same time as the SOX reform, may drive some of the findings of the paper. For example, if high volatility firms in the SOX-reform sample are largely Internet or NASDAQ firms, the burst of the Internet bubble or the NASDAQ crash could conceivably result in larger reductions in Tobin's Q and R&D expenses for such firms relative to low volatility firms. To address this concern, we exclude Internet or NASDAQ firms from the SOX-reform sample. If our findings are driven by the burst of Internet bubble or the NASDAQ crash, their exclusion should substantially weaken the results. Panel A of Table A5 reports the results based on the subsample that excludes Internet firms (3-digit SIC code 737). Clearly the main findings remain qualitatively unchanged. Panel B of the same table shows that removal of the NASDAQ firms from the sample does not affect the main findings in any qualitative manner either. Thus, the burst of the Internet bubble or the NASDAQ crash is unlikely to explain the findings.

The findings based on the SOX reform are unlikely to be driven by the economic recession in 2001 and subsequent recovery in 2002 and 2003 since our main results are based on the sample that excludes the 2000–2003 period. Similarly, the findings are unlikely to be explained by corporate fraud scandals, the Regulation Fair Disclosure or the Global Settlement. Corporate fraud scandals exposed pre SOX enactment are largely concentrated in the high growth "new economy" sector (e.g., Durnev and Mangen, 2009; Dechow et al., 2011), and our results do not change in any qualitative manner when we remove NASDAQ firms from the sample. Regulation FD was introduced by the SEC in October 2000 to reduce public companies' selective disclosure of material information to analysts and other investment professionals by requiring simultaneous disclosure of such information to the public. The literature on the effect of Regulation FD suggests that the regulation may have negatively impacted information availability,[7] which is in contrast to the finding of an increase in information availability for high volatility firms post the SOX reform. Enacted in April 2003, the Global Settlement, being designed to eliminate research analysts' conflicts of interest, could affect analyst forecast optimism, but should not affect the dependent variables we examine differentially across high versus low volatility firms.

6. Conclusion

In this paper, we examine the unintended agency costs of mandatory increase in information availability to firms with high

[7] For example, the literature documents a significant increase in analyst forecast dispersion following the enactment of Regulation FD (Bailey et al., 2003; Irani and Karamanou, 2003; Agrawal, Chadha and Chen, 2006).

performance volatility using the 2002 SOX reform as a quasi-natural experiment. We find that high volatility firms opt for low levels of information availability pre SOX. Post SOX, they experience an additional increase in information availability relative to low volatility firms. Meanwhile, high, relative to low, volatility firms also experience an increase in CEO turnover-to-performance sensitivity, a decline in R&D expenses, an increase in CEO compensation with the structure tilted towards more cash pay, and a reduction in firm value. Our findings are consistent with the 'managerial evaluation risk' hypothesis. As a robustness check, we further examine the 1970 mandatory quarterly reporting reform and again find that firms with high, relative to low, performance volatility experience an increase in information availability and a reduction in R&D expenses and firm value after the mandatory increase in financial reporting frequency.

We also check and find that the main findings of the paper are unlikely to be explained by alternative stories such as the 'proprietary information' hypothesis, the 'managerial effort' hypothesis, the pre-existing trends, the firm life-cycle explanation, the confounding events surrounding the SOX reform, etc. Overall, the evidence suggests that information availability is inversely related to performance volatility and mandating an increase in information availability, instead of benefiting shareholders, may impose additional agency costs to shareholders particularly for high volatility firms.

Appendix A

Table A1
Definition of variables.

Variable	Definition
Dispersion	The 12-month average of the inter-analyst standard deviation of analyst forecasts.
Synch	Log $(R^2/(1-R^2))$, where R^2 is the R^2 from the following firm-year-specific regression, $RET_{i,t} = \alpha + \beta_1 MARET_{i,t} + \beta_2 MARET_{i,t-1} + \beta_3 INDRET_{i,t} + \beta_4 INDRET_{i,t-1} + \varepsilon_{i,t}$, in which *RET* is the weekly stock return of the firm, *INDRET* is the weekly industry value-weighted return, and *MARET* is the weekly value-weighted market return.
CFO	Cash flow from operations excluding extraordinary items as a ratio of beginning total assets.
TA	The level of total accruals as a ratio of beginning total assets.
Turnover	A dummy which equals 1 if the CEO is forced to be replaced and equals 0 otherwise.
R&D	The R&D expense as a ratio of beginning total assets.
Pay	Total CEO compensation scaled by annual sales.
Cash Pay	CEO cash compensation (comprising of salary, bonus, non-equity incentive, pension and other compensation) scaled by annual sales.
Equity Pay	CEO equity compensation (i.e., options and stocks awarded) scaled by annual sales.
Q	Tobin's Q value of the firm.
Size	The log market capitalization.
FirmAge	The number of years since a firm is covered by the Compustat database.
Vol_RET	The standard deviation of industry-adjusted annual stock returns in the pre-reform period.
Vol_ROA	The standard deviation of industry-adjusted ROA in the pre-reform period.
Post	A dummy which equals 1 if the current fiscal year of observation belongs to the post-reform subperiod and equals 0 otherwise.
Divers	A revenue-based Herfindahl index of firm diversification using reported business segments.
Fundcorr	The logarithmic transformation of the R^2 (i.e., log $(R^2/(1-R^2))$) from a regression of the firm's quarterly ROA on value-weighted industry ROA, and is estimated every three years using past twelve quarterly observations in each firm-year-specific regression.
Cycle	Operation cycle, calculated as the sum of accounts receivable turnover days and inventory turnover days, scaled by 365.
SG	Sales growth rate.
ROA	Earnings excluding extraordinary items as a ratio of beginning total assets.
EPSchg	The absolute value of the difference between EPS in current fiscal year and EPS in last fiscal year, divided by the stock price at the beginning of the fiscal year.
Roecorr	The historical correlations between quarterly returns and earnings over the past twelve quarters.
Herf	The revenue-based Herfindahl index of industry-level concentration.
Nind	The average number of firms used to calculate the weekly industry return index.
Retcorr	The Spearman correlation between *MARET* and *INDRET* for each industry-year., in which *INDRET* is the weekly industry value-weighted return, and *MARET* is the weekly value-weighted market return.
InsTrd	The absolute value of the difference between total shares purchased by insiders and total shares sold by insiders during the calendar year as a fraction of average shares outstanding
Inst	The level of institutional ownership during the calendar year.
Nrev	The number of analyst forecast revisions of one-year-ahead forecasts of annual earnings during the calendar year.
RetDif	The difference between annual stock return of the firm and median annual return of the firms in the same industry.
RetInd	The median annual return of the firms in the same industry.
Lev	Total liabilities as a ratio of total assets.
BM	Book to market equity ratio.
Age	A dummy variable which equals 1 if the CEO is older than 60 years old and equals 0 otherwise.
AG	The growth rate in total assets.

The table provides a detailed description of the construction of the variables used in the paper.

Table A2
Robustness checks on industry adjustment.

Vol based on	SOX reform									1970 Reform		
	Dispersion	*Synch*	*CFO*	*Turnover*	*R&D*	*Pay*	*Cash Pay*	*Equity Pay*	*Q*	*Synch*	*R&D*	*Q*
Panel A: Volatility without industry adjustment												
Vol_RET	−0.029***(−2.58)	−0.247***(−3.55)	0.346***(2.67)	−0.727** (−2.45)	−0.030***(−10.80)	0.044** (2.40)	0.058***(5.31)	−0.051** (−2.18)	−1.144***(−14.94)	−0.199***(−4.43)	−0.002** (−2.16)	−0.224***(−6.17)
Vol_ROA	−0.462***(−5.36)	−3.018***(−5.51)	3.971***(4.07)	−7.629*** (−3.52)	−0.281***(−13.46)	0.300***(3.61)	0.410***(6.60)	−0.058** (−2.45)	−8.172***(−5.28)	−2.896***(−5.67)	−0.043**(−2.28)	−3.715***(−13.75)
Panel B: Volatility based as two-digit-SIC industry adjustment												
Vol_RET	−0.052***(−4.37)	−0.372***(−5.24)	0.295** (2.28)	−0.721** (−2.48)	−0.035***(−12.98)	0.043** (2.25)	0.055***(6.43)	−0.083***(−4.51)	−1.181***(−15.42)	−0.210***(−4.15)	−0.003** (−2.32)	−0.307***(−7.50)
Vol_ROA	−0.530***(−5.80)	−3.269***(−5.60)	3.771***(3.70)	−7.659*** (−3.57)	−0.316***(−14.27)	0.311***(3.53)	0.449***(6.73)	−0.072***(−5.47)	−8.276***(−6.72)	−2.672***(−4.94)	−0.041**(−2.06)	−3.702***(−13.64)

The table provides the regression results with various dependent variables based on both the SOX-reform sample and the 1970-reform sample. For expositional purpose, the table reports only coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics (in parentheses) for *Vol*Post* except when *CFO* (*Turnover*) is the dependent variable where it reports the coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics for *TA*Vol*Post* (z-statistics for *Vol*Post*ROA*). All variables have been described in Table A1. The corresponding control variables are also included in the regressions, but their regression coefficients are omitted from reporting for brevity. Firm and year fixed effects are controlled for except when *Turnover* is the dependent variable where industry and year fixed effects are controlled for. Panel A reports the results when performance volatility is calculated using stock returns or ROA without industry adjustment. Panel B provides the results when performance volatility is calculated using two-digit-SIC industry-adjusted stock returns or ROA. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A3
Pseudo-event tests.

Vol based on	SOX reform									1970 Reform		
	Dispersion	*Synch*	*CFO*	*Turnover*	*R&D*	*Pay*	*Cash Pay*	*Equity Pay*	*Q*	*Synch*	*R&D*	*Q*
Vol_RET	0.006 (1.24)	0.006 (0.28)	0.052 (1.16)	0.061 (0.73)	−0.001(−1.06)	−0.009(−0.68)	−0.001(−0.26)	−0.028(−0.69)	0.105(0.59)	0.108 (1.11)	0.001 (0.37)	0.103 (1.54)
Vol_ROA	0.201 (0.47)	1.628 (1.05)	0.104 (0.12)	1.68 (1.25)	−0.038 (−0.69)	−0.064 (−0.73)	−0.001 (−0.36)	−0.106 (−0.39)	1.004 (1.17)	2.221 (1.32)	0.005 (0.44)	0.063 (1.29)

The table provides the regression results with various dependent variables, using only the pre-reform subsamples for both the SOX-reform and the 1970-reform. For expositional purpose, the table reports only coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics (in parentheses) for *Vol*Post* except when *CFO* (*Turnover*) is the dependent variable where it reports the coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics for *TA*Vol*Post* (z-statistics for *Vol*Post*ROA*). In this test, pseudo-reform year is assumed to occur in the middle of the pre-reform period. All variables have been described in Table A1. The corresponding control variables are also included in the regressions, but their regression coefficients are omitted from reporting for brevity. Firm and year fixed effects are controlled for except when *Turnover* is the dependent variable where industry and year fixed effects are controlled for. The sample size is 4628 (564) firm-year observations for the SOX-reform (the 1970-reform). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A4
Robust tests based on subsamples that exclude young firms or high pre-reform R&D firms.

Vol based on	SOX reform									1970 Reform		
	Dispersion	*Synch*	*CFO*	*Turnover*	*R&D*	*Pay*	*Cash Pay*	*Equity Pay*	*Q*	*Synch*	*R&D*	*Q*
Panel A: Excluding young firms												
Vol_RET	−0.038** (−2.17)	−0.348***(−3.32)	0.269** (2.18)	−0.718** (−2.26)	−0.020***(−6.65)	0.064** (2.30)	0.066***(7.74)	−0.014 (−1.08)	−0.848***(−8.82)	−0.200** (−2.43)	−0.003***(−3.70)	−0.346***(−3.12)
Vol_ROA	−0.414***(−2.82)	−3.346***(−3.67)	3.499*** (2.93)	−7.026** (−2.26)	−0.231***(−8.96)	0.487***(4.16)	0.519***(6.87)	0.161 (1.47)	−5.898** (−2.06)	−3.120***(−3.23)	−0.043*** (−2.63)	−3.652***(−3.71)
Panel A: Excluding high pre-reform R&D firms												
Vol_RET	−0.045** (−2.14)	−0.175**(−2.22)	0.377** (2.46)	−0.326** (−2.06)	−0.010**(−2.46)	0.012*** (2.76)	0.029***(3.55)	−0.018* (−1.86)	−0.504***(−4.69)	−0.188*** (−3.68)	−0.003***(−4.23)	−0.189***(−5.29)
Vol_ROA	−0.342*(−1.78)	−2.180**(−2.41)	1.744* (1.87)	−3.418** (−1.98)	−0.105***(−2.69)	0.332**(2.44)	0.369***(5.82)	−0.009 (−1.36)	−2.229** (−2.28)	−2.802***(−4.85)	−0.051*** (−6.16)	−3.193***(−3.20)

The table provides the regression results with various dependent variables based on subsamples that exclude young firms or high pre-reform R&D firms for both the SOX-reform and the 1970-reform. For expositional purpose, the table reports only coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics (in parentheses) for *Vol*Post* except when CFO (*Turnover*) is the dependent variable where it reports the coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics for *TA*Vol*Post* (z-statistics for *Vol*Post*ROA*). All variables have been described in Table A1. The corresponding control variables are also included in the regressions, but their regression coefficients are omitted from reporting for brevity. Firm and year fixed effects are controlled for except when *Turnover* is the dependent variable where industry and year fixed effects are controlled for. Panel A reports the results based on the subsamples excluding young firms with firm age less than 20 years at the beginning of the SOX-reform or 1970-reform sample period according to their first CRSP appearances, with the sample size of 4709 (534) firm-year observations for the SOX-reform (1970-reform). Panel B provides the results based on the subsamples excluding firms having above-median average R&D expenses in the pre-reform periods, with the sample size of 3695 (423) firm-year observations for the SOX-reform (1970-reform). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A5
Robust tests based on subsamples that exclude internet firms or NASDAQ firms.

Vol based on	Dependent Variable								
	Dispersion	*Synch*	*CFO*	*Turnover*	*R&D*	*Pay*	*Cash Pay*	*Equity Pay*	*Q*
Panel A: Excluding internet firms									
Vol_RET	−0.033***(−2.61)	−0.349***(−4.65)	0.277** (2.27)	−0.831** (−2.45)	−0.026***(−9.94)	0.004** (2.37)	0.371***(6.92)	−0.041 (−1.64)	−0.981***(−12.92)
Vol_ROA	−0.494***(−5.03)	−3.227***(−5.15)	1.770* (1.67)	−6.683** (−2.34)	−0.251***(−11.58)	0.308***(3.37)	3.533***(7.86)	−1.083***(−5.16)	−6.304***(−5.17)
Panel B: Excluding NASDAQ firms									
Vol_RET	−0.026***(−3.55)	−0.176* (−1.67)	0.375** (2.20)	−0.726** (−2.31)	−0.005* (−1.79)	0.006** (2.48)	0.061* (1.86)	0.009 (0.39)	−0.937***(−10.87)
Vol_ROA	−0.557***(−4.09)	−3.071***(−3.23)	7.060***(5.12)	−6.562** (−2.19	−0.144***(−6.99)	0.375***(3.65)	0.562** (2.10)	−0.025 (−0.13)	−6.117***(−4.46)

The table provides the regression results with various dependent variables based on subsamples that exclude internet firms or NASDAQ firms in the SOX-reform period. For expositional purpose, the table reports only coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics (in parentheses) for *Vol*Post* except when CFO (*Turnover*) is the dependent variable where it reports the coefficient estimates and firm-clustering and heteroscedasticity robust t-statistics for *TA*Vol*Post* (z-statistics for *Vol*Post*ROA*). All variables have been described in Table A1. The corresponding control variables are also included in the regressions, but their regression coefficients are omitted from reporting for brevity. Firm and year fixed effects are controlled for except when *Turnover* is the dependent variable where industry and year fixed effects are controlled for. Panel A reports the results based on the subsample excluding Internet firms (3-digit SIC = 737), with the sample size of 6923 firm-year observations. Panel B provides the results based on the subsample excluding firms listed in NASDAQ, with the sample size of 5578 firm-year observations. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

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