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Crash Risk and the Auditor-Client Relationship*

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Crash Risk and the Auditor-Client Relationship

Abstract

This study examines whether the term of the auditor-client relationship (i.e., auditor tenure) is associated with future stock price crash risk measured both ex ante and ex post. Using a large sample of U.S. public firms with Big 4 auditors, we find robust evidence that auditor tenure is negatively related to one-year-ahead stock price crash risk. The evidence is consistent with monitoring-by-learning where development of client-specific knowledge over the term of the auditor-client relationship enhances auditors' ability to detect and deter bad news hoarding activities by clients, thereby reducing future crash risk. This result holds even after controlling for endogeneity of the tenure/crash risk relation. We further provide evidence indicating that option market investors do not *fully* incorporate the information contained in the term of auditor-client relationship in

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predicting future stock price crash risk. Our empirical results have important policy implications for regulators concerned with ensuring auditor independence.

JEL Classifications: G12; G34; M42

Keywords: crash risk; auditor-client relationship; agency conflicts; volatility smirk

1. Introduction

The purpose of this paper is to explore the association between the term of the auditor-client relationship (i.e., auditor tenure) and future stock price crash risk. Our focus is motivated by extant accounting academic research, anecdotal evidence and the bad news hoarding theory of crash risk. Academic research suggests that potential litigation concerns incentivize auditors to closely monitor clients' reporting choices that might mask bad news (e.g., Lys and Watts 1994; Heninger 2001; Baron et al. 2001; Kim et al. 2003; Abbott et al. 2006; DeFond et al. 2012).[1] This motivation is especially likely to be true of Big 4 auditors that have greater incentives to provide higher-quality audits because their "deep pockets" subject them to more litigation risk (e.g., DeFond and Zhang 2014).[2] In contrast, the recent financial crisis has reignited public discussion regarding the willingness of auditors to monitor bad news reporting of clients (PCAOB 2010; Financial Crisis Inquiry Commission 2011). Specifically, a series of recent crisis-related cases challenge the notion that auditors help to prevent managerial bad news hoarding activities in public firms.[3] Auditors are alleged in these cases to have turned a blind eye to managerial manipulative practices that hide negative information from the public (e.g., Valukas 2010; Goldfarb 2010; Coffee 2014; Wiggins et al. 2015).[4] For example, concerning usage of off-balance sheet devices to mask bad news, Ernst & Young, external auditors for Lehman Brothers Holdings Inc. (Lehman), were accused of failing to "follow professional standards of care with respect to communications with Lehman's Audit Committee, investigation of a whistleblower claim, and audits and reviews of Lehman's

[1] Another two engagement risks to which auditors are exposed are reputation risk and regulation risk (Knechel et al. 2007a). These risks are not completely independent. Litigation concerns are more likely to discipline auditors when they are also concerned about protecting their reputation and avoiding regulatory intervention.

[2] For simplicity, we refer to the set of Big 4 auditors and their predecessors (i.e., Big 5, Big 6, and Big 8 auditors) as the Big 4 auditors in this paper.

[3] "Two Auditors Charged Over Bank Failure." (*Wall Street Journal,* Jan 9, 2013*;* http://online.wsj.com/article/SB10001424127887324442304578231963265786232.html).

[4] Valukas 2010, Lehman Brothers Holdings Inc. Chapter 11 Proceedings Examiner's Report Volume 3, pages 765, 948-950, 990-991, and 1027-1053 (http://lehmanreport.jenner.com/).

public filings” (Valukas 2010, 1027). Importantly, Ernst & Young had an extensive long-term relationship with Lehman.[5]

Such high-profile audit failures tend to elicit a jaundiced view of the auditor-client relationship. Indeed, among other explanations, commentators in the *Wall Street Journal* blamed the long-running auditor-client relationship between Ernst & Young and Lehman as contributing to weak auditor independence and fostering managerial bad news hoarding (e.g., Westbrook and Katz 2010; Rappaport and Rapoport 2010; Rapoport 2010). In August 2011, the Public Company Accounting Oversight Board (PCAOB) expressed similar concerns by issuing a concept release on auditor independence and rotation (PCAOB 2011a).

Despite the concerns above, it is not obvious that a longer auditor-client relationship leads to more managerial bad news hoarding. On one hand, developing client-specific knowledge may be crucial if auditors are to detect and deter bad news hoarding activity by clients. Over time, auditors gain a better understanding of their client’s business and learn more regarding the critical issues that necessitate specific attention (e.g., Knapp 1991; Johnstone et al. 2001; Johnson et al. 2002; PricewaterhouseCoopers 2002; Beck and Wu 2006; PCAOB 2011b; PricewaterhouseCoopers 2013). This “monitoring-by-learning” perspective implies that longer auditor tenure helps to preempt bad news hoarding activities by clients. On the other hand, if a long-run association with the same client reduces auditor independence (e.g., Mautz and Sharaf 1961; U.S. Senate Metcalf Committee Report 1976; Turner 2002; Carey and Simnett 2006; Davis et al. 2009; PCAOB 2011a), auditors with longer tenure may be less vigilant about bad news hoarding activities by their clients.

Measuring bad news hoarding by managers is challenging because managers have multiple channels (e.g., accrual manipulation, classification shifting, off-balance sheet devices, and opaque notes accompanying financial statements) by which to mask bad economic news. For example, Enron and Lehman employed off-balance sheet devices to withhold negative information (Powers et al. 2002; Valukas 2010). Even though these accounting maneuvers are within the scope of professional auditing, their effects are beyond those captured by accrual manipulation or financial reporting numbers simply because they are off-balance sheet. Similarly, classification shifting and the quality of the notes that accompany financial statements fall within the purview of auditors but they are not reflected in accrual manipulation metrics either (e.g., McVay 2006; Fan et al. 2010; Lee 2012; Ghosh and Tang 2015a).[6] Instead, based on the literature on crash risk (e.g., Jin and Myers 2006; Hutton et al. 2009; Kim et al. 2011a, 2011b), our approach advances the notion that the market-based risk

[5] Public data source shows that Lehman had a 19-year relationship with Ernst & Young.

[6] McVay (2006) and Lee (2012) list a few examples of companies engaging in classification shifting to mask deteriorating financial performance, including Borden Inc., AmeriServe Food Distribution, SmarTalk, Waste Management, Anicom, Enron, and Dynegy.

measure of stock price crash risk is a far more comprehensive metric that should reflect *all* manner of managerial bad news hoarding in comparison to a specific channel metric such as accruals manipulation or classification shifting. Precisely because there are so many options for hoarding bad news in ways not captured by specific financial reporting metrics, a returns-based metric of bad news hoarding is essential. Utilizing a market-based measure of bad news hoarding minimizes the likelihood that the researcher will draw false inferences regarding the relationship between auditor tenure and managerial bad news hoarding. Alternative metrics such as restatements and going-concern opinions are also problematic because they are rare and extreme events, and do not necessarily signify a general policy of managerial bad news hoarding (e.g. Plumlee and Yohn 2010; DeFond and Zhang 2014).[7] Compared to these metrics, our evidence founded on a market-based risk measure offers generalizable inferences concerning the impact of auditor tenure on managerial bad news hoarding for a broad sample of firms.

Using a large sample of U.S. public firms audited by Big 4 audit firms for the years 1981 to 2011, we examine the empirical link between auditor tenure and future stock price crash risk. Contrary to recent concerns raised about long-term auditor-client relationships, we find compelling evidence that auditor tenure is negatively related to one-year-ahead stock price crash risk. This evidence is consistent with the monitoring-by-learning perspective that developing client-specific knowledge over the term of the auditor-client relationship enables auditors to effectively detect and deter bad news hoarding activities by the client. Our findings are robust to a series of tests including alternative measures of crash risk and auditor tenure, alternative econometric models, and alternative empirical specifications. We continue to find supportive evidence when we address the potential endogeneity of auditor tenure by using multiple identification strategies including restricting the analysis to firms with long auditor tenure, subsample analyses based on agency conflicts, two-stage least squares regressions, and a natural experiment.

The natural experiment identification strategy relies on the exogenous shock to auditor tenure induced by the demise of Arthur Andersen (AA) in 2002. This shock affected auditor tenure of former AA clients but had no direct impact on stock price crash risk. Using a difference-in-differences approach, we show that compared to the control group, the treatment group (i.e., former AA clients) experienced a relative increase in stock price crash risk in the period after the forced disruption of their long-term auditor relationship with AA and

[7] A review paper by DeFond and Zhang (2014) also indicates that traditional measures of accrual quality are noisy and potentially biased, so that omitted correlated variables and construct validity may plague studies relying on abnormal accruals to proxy for earnings management or audit quality. Francis et al. (2013) raise another related limitation of accrual quality measures, namely, that they only measure the abnormal part of earnings relative to statistical norms and thus do not reflect the economic impact of aggressive accounting policies.

engagement with a new successive Big 4 auditor. The results continue to hold under alternative specifications. Overall, our identification tests suggest that auditor tenure has a negative causal effect on stock price crash risk.

Does the market recognize ex ante the impact of auditor tenure on crash risk? We address this question by focusing on the option smirk curve, an indicator of ex ante crash risk as perceived by investors. Specifically, we provide evidence suggesting that option market investors do not *fully* impound the information conveyed by the term of the auditor-client relationship in predicting future crash risk. In particular, auditor tenure forecasts future crash risk beyond the information already implied in the option smirk curve.

Our study provides a number of important contributions to the literature. First, we extend auditing research on the auditor-client relationship by investigating the relation between auditor tenure and future crash risk. Specifically, we contribute to the ongoing discussion on the auditor-client relationship by focusing on higher moments of the stock return distribution (i.e., extreme negative returns) and by providing new evidence concerning the economic consequences of auditor tenure. Unlike prior studies that rely on a single channel metric to proxy for audit quality such as accrual quality and disregard other components of financial reporting (e.g., classification shifting, off-balance sheet devices, and the opacity of notes accompanying the financial statements), we use a market-based comprehensive measure of bad news hoarding to measure audit quality.[8] After all, high-quality audits are more likely to preempt managerial bad news hoarding of all types in comparison to lower-quality audits. Thus, utilizing stock price crash risk to reflect overall managerial bad news hoarding provides more compelling evidence of audit quality than metrics that are specific to one channel such as accrual manipulation, classification shifting, or off-balance sheet methods.

Second, our evidence shows material benefits that the external auditor brings to equity markets in the form of reduced extreme downside risk. Studies indicate that investors consider extreme outcomes in equity markets important in affecting their welfare (Xing, Zhang, and Zhao 2010; Yan 2011; Kelly and Jiang 2014). Further, Sunder (2010) emphasizes that, in contrast to risks arising from symmetric return variations, extreme downside risk can only be mitigated through screening, not diversification. By showing that longer auditor tenure reduces crash risk, our findings increase our understanding regarding the external governance role that professional auditors play in influencing overall investor welfare.

Third, DeFond and Zhang (2014), in discussing the strengths and weaknesses of a series of proxies for audit effectiveness (e.g., accruals, restatements, and going-concern opinions), suggest choosing audit quality

[8] Ghosh and Tang (2015a) raise the similar concern that prior studies examining audit quality rely on specific numbers from the financial statements (e.g., accruals) but neglect other components of financial reporting (e.g., notes accompanying financial statements).

proxies that are most appropriate for the research settings examined, and explicitly call for research to carefully articulate the inferences that can be drawn from the proxies employed. They also urge more research on the role of auditor competencies on audit quality. We undertake such an endeavor by using a market-based metric of auditor effectiveness.

Finally, our study also contributes to the policy-oriented debate on the failure of external auditors to preempt managerial bad news hoarding during the recent financial crisis.[9] In April 2011, the Senate Subcommittee on Securities, Insurance and Investment conducted a hearing on "The Role of the Accounting Profession in Preventing another Financial Crisis" to further examine the role of auditors in the recent financial crisis. The recent charge against KPMG employees in the Omaha office by the Securities and Exchange Commission (SEC) for failure to uncover hidden losses at TierOne Bank marks the first time that the agency has imposed the legal action against professional auditors in connection with the financial crisis (Rapoport 2013).[10] Our evidence reinforces current regulation policy regarding voluntary auditor rotation by providing large-sample evidence that longer auditor tenure helps to ensure the well-functioning of capital markets through preempting managerial bad news hoarding and thus reducing the incidence of stock price crashes.[11]

The paper proceeds as follows. Section 2 reviews prior literature and develops our hypotheses. Section 3 describes the sample, variable measurement, and research design. Section 4 presents the empirical results. Section 5 concludes.

2. Literature review and hypothesis development

Literature review

Past studies maintain that managers suppress negative news from investors as long as possible due to various concerns including career trajectory, short-term compensation, and empire building (e.g., Basu 1997; Ball 2009; Kothari et al. 2009; Kim et al. 2011b). The survey by Graham et al. (2005) finds that managers are prone to delaying the release of bad news relative to good news. Anecdotal evidence in recent decades sheds further light on the issue of managerial bad news hoarding in listed firms. For instance, using Special Purpose

[9] In her testimony before the Financial Crisis Inquiry Commission in Jan 2010, SEC Chairman Mary L. Schapiro stated that "a central question in many of the cases brought by the SEC is whether investors received timely and accurate disclosure concerning deteriorating business conditions, increased risks, and downward pressure on asset values" (Schapiro 2010: para. 10).

[10] Similarly, the New York Attorney General's office filed a lawsuit against Ernst & Young, alleging that the firm turned a blind eye to accounting gimmicks that masked bad news at Lehman before Lehman failed.

[11] "The U.S. government's auditor watchdog finally said Thursday it is no longer pursuing a project to impose auditor term limits on public companies, nearly three years after proposing the idea." ("PCAOB's Auditor Rotation Project is Essentially Dead," Feb 5, 2014, http://blogs.wsj.com/cfo/2014/02/05/pcaobs-auditor-rotation-project-is-essentially-dead/.

Vehicles, Enron was able to conceal money-losing assets for an extended period before the cumulative losses became unsustainable (Powers et al. 2002). To minimize reported leverage, Lehman set up off-balance sheet mechanisms called "Repo 105s" during 2007 and 2008 to provisionally eliminate securities inventory from its balance sheet (Valukas 2010).[12]

Jin and Myers (2006, 259) were the first to explore how bad news hoarding leads to stock price crash risk. They point out that, "the amount of bad news that insiders are willing to absorb is limited. If a sufficiently long run of bad firm-specific news is encountered, insiders give up and all the bad news comes out at once. Giving up means a large negative outlier in the distribution of returns [a crash]." Similarly, Hutton et al. (2009, 70) argue that "firms managing reported earnings shelter bad information up to a point, but that once a threshold is crossed, the information comes out in one fell swoop, at which point a price crash is observed."

Empirical evidence aligns with the bad news hoarding theory of crash risk. Jin and Myers (2006) and Hutton et al. (2009) provide evidence that opacity is positively associated with firm-specific stock price crash risk at the country and firm levels, respectively. Kim et al. (2011a,b) find that tax avoidance activities and CFOs' option holdings are two important determinants of firm-specific stock price crash risk. Research also shows that crash risk falls with the degree of institutional investor stability and the level of religiosity in counties where firms are headquartered, which engender disincentives for managers to suppress bad news (Callen and Fang 2013, 2015).

Prior audit studies suggest that when facing potential litigation risks, auditors will respond asymmetrically to clients' financial reporting system by more closely monitoring managerial behavior that potentially masks bad economic news (e.g., Kim et al. 2003; Abbott et al. 2006; DeFond et al. 2012). Similarly, Kothari et al. (2009, 255) note that "before signing off on audited financial statements, auditors in the fourth quarter ascertain whether any assets are impaired and whether there are any other unrecorded losses. This scrutiny has the potential to uncover bad news that must be recognized in the financial statements." Anecdotally, some SEC litigation releases also suggest that auditors constrain managerial bad news hoarding through specific reporting channels (e.g., classification shifting and notes disclosure).[13] However, recent accounting scandals (e.g., Lehman) suggest that a long auditor-client relationship leads to a lack of auditor independence, thereby

[12] Similarly, WorldCom and New Century also engaged in bad news hoarding through fraudulent accounting methods or by failing to disclose information regarding the subprime mortgage business (Beresford, Katzenbach, and Rogers 2003; Schapiro 2010).

[13] For instance, for years 1999 to 2002, Qwest engaged in a massive financial misconduct, i.e., fraudulently recognizing nonrecurring revenues from one-time sales of assets as recurring in order to meet aggressive targets for Qwest's revenue and earnings growth. Its auditor, Arthur Andersen, questioned the propriety of the accounting treatment (i.e., classification shifting) and insisted that Qwest should provide detailed disclosure in the footnotes to financial statements for these transactions (https://www.sec.gov/litigation/litreleases/2007/lr20138.htm; https://www.sec.gov/litigation/complaints/2007/comp20138.pdf).

facilitating managerial bad news hoarding through a number of channels (e.g., Valukas 2010; Wiggins et al. 2015). Commentators on Wall Street partially attributed these events to the long-running auditor-client relationship (e.g., Westbrook and Katz 2010; Rappaport and Rapoport 2010; Rapoport 2010). In August 2011, PCAOB expressed similar concerns regarding auditor independence and proposed audit firm rotation (PCAOB 2011a).

Extant research provides conflicting findings regarding the relation between auditor tenure and audit quality. Some studies suggest that long tenure improves audit quality by providing evidence that auditor tenure is positively associated with the incidence of going-concern opinions (Louwers 1998), accrual quality (Johnson et al. 2002; Myers et al. 2003), earnings response coefficients (Ghosh and Moon 2005), and a reduction in the frequency of financial restatements (Stanley and DeZoort 2007).[14] In contrast, other research implies that long auditor tenure is associated with worse audit quality, including a lower likelihood of issuing a going-concern opinion and the propensity to just beat earnings benchmarks (Carey and Simnett 2006). Kealey et al. (2007) find that audit fees charged by successor auditors are positively related to prior auditor-client tenure. In a similar vein, Myers et al. (2005) provide evidence that market reactions to the announcement of auditor turnover following restatements are positively related to prior auditor-client tenure. Further, Davis et al. (2009) find that increased use of discretionary accruals to meet or beat earnings forecasts is associated with both short and long auditor tenure. In addition, some studies show that long auditor tenure does not affect cost of debt in private firms (Fortin and Pittman 2007) or audit adjustments (Joe et al. 2011). Thus, based on past literature, one cannot unambiguously conclude that longer auditor-client relationships have a positive impact on audit quality.

Hypothesis development

In this study, we extend the literature by investigating the role of external auditors in influencing future stock price crash risk induced by managerial bad news hoarding activities. On one hand, an auditor's knowledge of his specific client provides a crucial input for generating high-quality audits, including detecting and deterring bad news hoarding activity by management. Acquiring client-related knowledge involves a considerable learning curve in the early years of an engagement, especially as it pertains to learning the potential multiple channels by which the client can hoard bad news. Auditors over time gradually gain a better understanding of their client's business and learn more regarding crucial issues that necessitate specific attention (Knapp 1991; Johnstone et al. 2001; Johnson et al. 2002; Beck and Wu 2006; PricewaterhouseCoopers 2002,

[14] See also St. Pierre and Anderson (1984), Mansi et al. (2004), Knechel and Vanstraelen (2007b), Gul et al. (2007), and Chen et al. (2008).

2013).[15] In testifying before the U.S. Senate, Roderick M. Hills, a former SEC Chairman, opined: "The longer an auditor is with a company the more it learns about its personnel, its business, and its intrinsic values. To change every several years will simply create a merry-go-round of mediocrity." (Hills 2002, para. 62). From this "monitoring-by-learning" perspective, longer auditor tenure should help to preempt bad news hoarding activities by clients in all manners of financial reporting, and therefore reduce future stock price crash risk.

On the other hand, a contrary perspective has often been raised by academics, congressional bodies and regulators with respect to auditor independence. Mautz and Sharaf (1961) argue that a long-run association with the same client reduces auditor independence.[16] The U.S. Senate Metcalf Committee report (1976, 21) expressed the concern that "long association between a corporation and an accounting firm may lead to such close identification of the accounting firm with the interests of its client's management that truly independent action by the accounting firm becomes difficult." The report of the Commission on Auditors' Responsibilities (AICPA 1978) noted that as auditor tenure increases, auditors are more likely to acquiesce to pressure from their client on financial reporting choices because they are overly familiar with client management ("the cognitive argument") and because they want to retain the client's business in order to profit from it ("the incentive argument"). In 2011, the PCAOB solicited opinions on whether it should mandate listed companies to rotate their auditors every few years in order to mitigate the potential negative impact of long auditor tenure on auditor independence (PCAOB 2011a). Thus, from this "cognitive-incentive" perspective, auditors with long tenure are less likely to be independent and, hence, less vigilant about bad news hoarding activities by their client, thereby increasing future stock price crash risk.

Consequently, the relation between auditor tenure and future crash risk is unclear ex ante. Given these contradictory perspectives, the relation between auditor tenure and future crash risk is an empirical question and we formulate our hypothesis in (the alternative) nondirectional form:

HYPOTHESIS 1. *Auditor tenure is related to future firm-specific stock price crash risk.*

[15] Indeed, empirical evidence shows that audit litigation risk and audit failures are higher during the early years of the auditor-client relationship (Palmrose 1991; Geiger and Raghunandan 2002; Carcello and Nagy 2004).

[16] Mautz and Sharaf (1961, 208) maintain that "the greatest threat to his [the auditor's] independence is a slow, gradual, almost casual erosion of his honest disinterestedness."

3. Sample, variables, and descriptive statistics

The sample

The initial sample comprises firm-year observations for which auditor information is available on COMPUSTAT. Consistent with prior studies (Mansi et al. 2004; Ghosh and Moon 2005; Gul et al. 2009; Lim and Tan 2010), we measure auditor tenure (*TENURE*) as the number of consecutive fiscal years that the auditor has been retained by the client, up to and including the current year. In the situation of audit firm mergers, the incumbent auditor–client relationship is assumed to be the continuation of the prior auditor. We collect: (1) daily stock data from CRSP; (2) accounting data from COMPUSTAT annual files; (3) analyst data from I/B/E/S; and (4) institutional ownership data from the Thomson Reuters database. We further exclude observations with nonpositive total assets and equity book values, observations with year-end share prices less than one dollar, and observations with fewer than six months of CRSP return data available. Given the relative dominance of the Big 4 audit firms in the audits of publicly listed companies, we restrict our sample to Big 4 auditors. This also avoids the potential confounding issue that audit quality differs for companies audited by Big 4 auditors versus non-Big 4 auditors due to differences in auditor characteristics (Johnson et al. 2002; Francis et al. 1999; Teoh and Wong 1993). Our final sample consists of 56,667 firm-year observations for the years 1981 to 2011 inclusive.

Measurement of firm-specific crash risk

Firm-specific daily returns are a critical input into calculating various metrics of firm-specific stock price crash risk. Following Hutton et al. (2009), we estimate firm-specific daily returns from the following expanded market and industry index model regression for each firm and year:

$$r_{jt} = \alpha_j + \beta_{1j} r_{m(t-1)} + \beta_{2j} r_{i(t-1)} + \beta_{3j} r_{mt} + \beta_{4j} r_{it} + \beta_{5j} r_{m(t+1)} + \beta_{6j} r_{i(t+1)} + \varepsilon_{jt} ,$$

(1)

where r_{jt} is the return on stock *j* in day *t*, r_{mt} is the return on the CRSP value-weighted market index in day *t*, and r_{it} is the return on the value-weighted industry (i.e., the two-digit SIC code) index. To account for nonsynchronous trading, we include lead and lag terms for the value-weighted market and industry indices in the regression (Dimson 1979). The firm-specific daily return, R_{jt}, is defined as the natural log of one plus the residual return from equation (1). We log transform the raw residual returns to reduce the positive skew in the return distribution and help ensure symmetry (Chen et al. 2001).[17]

Based on prior studies (e.g., Chen et al. 2001; Jin and Myers 2006; Hutton et al. 2009; Callen and Fang 2015), we calculate three measures of (ex post) firm-specific crash risk for each firm-year observation.

Our first measure of firm-specific crash risk is the negative coefficient of skewness (*NCSKEW*), that is, the negative of the third moment of each stock's firm-specific daily returns divided by the cubed standard deviation. Thus, for any stock *j* over the fiscal year *T*,

$$NCSKEW_{jT} = -\left(n(n-1)^{3/2}\sum R_{jt}^{3}\right)\Big/\left((n-1)(n-2)(\sum R_{jt}^{2})^{3/2}\right),$$

(2)

where *n* is the number of observations for stock *j* during the fiscal year *T*. The denominator is a normalization factor (Greene 1993).[18]

Our second measure of crash risk is the down-to-up volatility of firm-specific daily returns (*DUVOL*) calculated as follows:

$$DUVOL_{jT} = \log\left\{(n_u - 1)\sum_{DOWN} R_{jt}^{2} \Big/ (n_d - 1)\sum_{UP} R_{jt}^{2}\right\},$$

(3)

where n_u and n_d are the number of up and down days over the fiscal year *T*, respectively. For any stock *j* over a one-year period, we denote days with firm-specific daily returns above (below) the mean of the period as the "up" ("down") sample. We further compute the standard deviation for each sample separately. *DUVOL* is the log ratio of the standard deviation of the "down" sample to the standard deviation of the "up" sample.

Our third measure is the number of days with negative extreme firm-specific daily returns minus the number of days with positive extreme firm-specific daily returns (*COUNT*). A firm-specific daily return is regarded as a negative (positive) extreme return if it exceeds 3.09 standard deviations below (above) the mean firm-specific daily return over the fiscal year, with 3.09 selected as a cutoff to yield frequencies of 0.1 percent in the normal distribution (Hutton et al. 2009).

In our empirical tests, we employ one-year-ahead *NCSKEW* ($NCSKEW_{T+1}$), *DUVOL* ($DUVOL_{T+1}$), and *COUNT* ($COUNT_{T+1}$) as the dependent variables.

[17] Our results (untabulated) remain robust if we measure firm-specific crash risk based on raw residual returns.
[18] Higher values of *NCSKEW*, *DUVOL* and *COUNT* imply higher crash risk.

Control variables

We control for variables known to affect crash risk from prior literature (e.g., Chen et al. 2001; Jin and Myers 2006; Hutton et al. 2009). Specifically, our controls include: current period negative skewness (*NCSKEW)*; kurtosis of firm-specific daily returns in the fiscal year (*KUR*); standard deviation of firm-specific daily returns in the fiscal year (*SIGMA*); cumulative firm-specific daily returns in the fiscal year multiplied by 100 (*RET*); market-to-book ratio at the end of fiscal year (*MB*); leverage defined as the book value of all liabilities divided by total assets at the end of the fiscal year (*LEV*); return on assets defined as operating earnings divided by total assets at the end of the fiscal year (*ROA*); firm size defined as the log of market value of equity at the end of fiscal year (*LNSIZE*); and average monthly share turnover over the fiscal year minus the average monthly share turnover over the previous year (*DTURN*), where monthly share turnover is calculated as the monthly share trading volume divided by the number of shares outstanding over the month.

Following Hutton et al. (2009), we further control for firm-level accrual manipulation (*ACCRM*), measured as the moving sum of the absolute value of annual performance-adjusted discretionary accruals for the past three years (Kothari, Leone, and Wasley 2005). We also control for firm age (*AGE*), measured as the number of years that the firm has been listed on COMPUSTAT since 1950, because the audit literature documents a high correlation between auditor tenure and firm age (e.g., Ghosh and Moon 2005; Gul et al. 2009). We follow Chen et al. (2001) and control for the log value of one plus the number of analysts following the firm (*ANA*). Finally, we also control for the percentage of equity ownership by transient institutional investors (*TRA*) (Callen and Fang 2013).[19]

An Appendix provides definitions of the variables used in this study.

Descriptive statistics

Table 1, panel A presents descriptive statistics for the variables used in our regression models. The mean values of $NCSKEW_{T+1}$, $DUVOL_{T+1}$, and $COUNT_{T+1}$ are −0.1407, −0.1699, and −0.4240, respectively. The mean and standard deviation of $NCSKEW_{T+1}$ and $DUVOL_{T+1}$ are similar to those reported by Chen et al. (2001). The mean value and standard deviation of *TENURE* are 10.581 and 7.327, comparable to prior studies (e.g., Ghosh and Moon 2005; Lim and Tan 2010). Panel B presents a Pearson correlation matrix for the variables used in our study. $NCSKEW_{T+1}$, $DUVOL_{T+1}$, and $COUNT_{T+1}$ are all significantly and positively correlated with each other.

[19] Bushee's website (http://acct3.wharton.upenn.edu/faculty/bushee/IIvars.html#typ) provides information regarding institutional investors types starting from year 1981.

The correlation coefficients between *TENURE* and the three future crash risk measures provide hardly any preliminary support for the prediction in H1.

Figure 1 highlights the means of *NCSKEW*, *DUVOL*, and *COUNT* across the sample years 1981 to 2011. Consistent with Fang et al. (2009), firm-specific crash risk spiked from 2000 to 2002 and fell dramatically afterwards, supporting the argument that the Sarbanes-Oxley Act attenuated withholding of bad news. Unsurprisingly, the figure also shows that firm-specific crash risk rose again in 2007, coinciding with the beginning of the recent U.S. banking crisis.

4. Empirical tests

Main results: The impact of auditor tenure on crash risk

To test our hypothesis regarding the relation between auditor tenure and future firm-specific price crash risk, we estimate the regression:

$$CRASHRISK_{jT+1} = \alpha_0 + \alpha_1 TENURE_{jT} + \sum_k \alpha_k Controls_{jT}^k + \gamma_T + \delta_i + \varepsilon_{jT}, \quad (4)$$

where $CRASHRISK_{T+1}$ is measured by one of $NCSKEW_{T+1}$, $DUVOL_{T+1}$, and $COUNT_{T+1}$. γ_T and δ_i are year and industry fixed effects, respectively. Regression equations are estimated using pooled Ordinary Least Squares (OLS) with White standard errors corrected for firm clustering. Our focus is on the impact of *TENURE* on future crash risk, that is, the coefficient α_1.[20]

Table 2 shows the regression results for equation (4) where future firm-specific price crash risk is measured by one-year-ahead *NCSKEW*, *DUVOL,* and *COUNT* in Models 1 to 3, respectively. Across all three models, the coefficient on *TENURE* is negative and significant at less than a 5 percent significance level (*t*-statistics= −2.43, −2.66, and −3.13, two-tailed). These findings are consistent with the monitoring-by-learning perspective that developing client-specific knowledge over the term of the auditor-client relationship effectively detects and deters bad news hoarding activities by the client, thus reducing future stock price crash risk. Following Hutton et al. (2009), the economic significance of these findings is calculated by comparing crash risk at the 25th and 75th percentile values of *TENURE* while holding all other variables at their mean values. The economic impact on crash risk is about 11.84 percent of the sample mean. The specific percentages for one-year-ahead *NCSKEW, DUVOL,* and *COUNT* are 19.19 percent, 7.42 percent, and 8.92 percent, respectively.[21]

[20] Here, we winsorize top/bottom 1 percentile of regressor outliers, but not the dependent variables, to control for the potential influence of outliers. Our results remained qualitatively similar without winsorizing.

[21] In comparison, the economic impact of accrual manipulation on crash risk is, on average, about 12.31 percent of the

Prior studies (Johnson et al. 2002; Myers et al. 2003) find a negative relation between auditor tenure and the absolute value of discretionary accruals. Hutton et al. (2009) further find that firms that manipulate accruals tend to suffer future price crashes. Hence, we explicitly include *ACCRM* as a control to help dispel the concern that the relation between auditor tenure and future stock price crash risk is simply driven by accrual manipulation. Untabulated robustness results show that even if we exclude *ACCRM* from the regressions, the estimated *TENURE* coefficients—in both magnitude and statistical significance—are similar to those of Table 2, indicating that accrual manipulation is only one of various ways by which auditor tenure affects managerial bad news hoarding behavior. In addition, we find that the estimated coefficients on most of the other control variables, including *RET*, *LNSIZE*, *DTURN*, *MB*, *LEV*, and *TRA*, are highly significant across all of the three models and are consistent with the signs in the literature (Harvey and Siddique 2000; Chen et al. 2001; Hutton et al. 2009; Callen and Fang 2013). We also observe that the coefficients on *AGE* are insignificant, suggesting that *TENURE* does not proxy for *AGE*.[22]

We perform a number of sensitivity analyses of our main results. To economize on space, we report results only when future stock price crash risk is measured by one-year-ahead *NCSKEW*. The regression analyses using one-year-ahead *DUVOL* and *COUNT* (untabulated) are qualitatively similar. First, we use alternatively both the natural log and a dummy variable measure based on the sample median for *TENURE* in regression equation (4). The results in Models 1 and 2 of Table 3 are consistent with those reported in main analyses. In a further sensitivity analysis, we estimate equation (4) annually from 1981 to 2011 using the approach of Fama and MacBeth (1973). The coefficient on *TENURE* in Model 3 remains significantly negative at the 5 percent level.

As a robustness check, we also use the accrual quality measure of Dechow-Dichev (2002), as modified by Francis et al. (2005), to control for financial reporting quality. Model 4 of Table 3 shows that the estimated coefficient of *TENURE* remains significantly negative, indicating that our results are robust to alternative proxies for accrual manipulation. Jenkins and Velury (2008) document a positive association between conservatism in earnings and auditor tenure. Although crash risk is conceptually distinct from accounting conservatism, we control for the firm-year-measure of conservatism of Khan and Watts (2009). The result remains robust in Model 5.

To address the concern that omitted time-invariant characteristics of client firms may be driving the results, we add firm-level fixed effects in regression equation (4). Omitted variables affecting client firm's

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sample mean.

[22] The variance inflation factors (VIF) for *TENURE* and *AGE* are around 2, well below the commonly accepted threshold of 10, suggesting that multicollinearity is not an issue. After excluding *AGE*, the results on *TENURE* (untabulated) remain essentially unchanged.

choice of auditor and future stock price crash risk could lead to spurious correlations between auditor tenure and future stock price crash risk. Implementation of firm fixed-effect regressions helps address the threat posed by endogeneity, that is, time-invariant selectivity. Our results still hold after including firm fixed effects in Model 6 of Table 3.

Endogeneity tests

We presuppose that auditor tenure influences crash risk. However, it is likely that crash risk and auditor tenure are endogenously determined, that is, auditors are less (more) likely to drop clients with low (high) crash risk or that auditor tenure and crash risk are simultaneously determined by other exogenous variables. Employing a one-year- ahead regression model to forecast crash risk in the main analyses helps to alleviate endogeneity concerns.[23] Nevertheless, we implement additional tests to make more robust inferences about the impact of *TENURE* on crash risk. In total, we conduct four different identification tests to control for the potential endogeneity of auditor tenure. Here, we report results only when future crash risk is measured by one-year-ahead *NCSKEW*. The regression analyses using one-year-ahead *DUVOL* and *COUNT* (untabulated) are qualitatively similar.

Long-tenure sample

We follow the literature (e.g., Myers et al. 2003; Ghosh and Moon 2005; Caramanis and Lennox 2008; Lennox and Pittman 2010) and construct a subsample in which auditor tenure lasts for at least five years. This subsample helps to address the potential concern that frequent auditor turnover for clients with high crash risk is driving the negative relation between auditor tenure and crash risk. If the latter supposition is correct, we should not expect to observe a negative relation in a long-tenure sample where auditor choice is essentially predetermined. In fact, it is more defensible and reasonable to treat auditor choice as predetermined when auditor tenure is long, and thus focusing on long-tenure firms has become a standard approach for addressing endogeneity in audit settings (e.g, Myers et al. 2003; Caramanis and Lennox 2008; Chang, Dasgupta, and Hilary 2009; Lennox and Pittman 2010).

Re-estimating equation (4) on this subsample, the coefficient on *TENURE* in Model 1 of panel A, Table 4, is negative and significant at less than a 1 percent significance level. Importantly, the magnitude and

[23] As an additional test, we examine whether firm-specific crash risk is correlated with future and contemporaneous auditor tenure. If firm-specific crash risk affects auditor tenure, our main results should capture causality in the opposite direction. Untabulated results show an insignificant association between *TENURE* in year *T*+1 (*T*) and *NCSKEW* in year *T*, suggesting that causality is from the term of the auditor-client relationship to stock price crash risk, rather than the other way around.

significance of the coefficient on *TENURE* are even stronger than those reported in the main regression of Table 2. We also examine whether our results are materially sensitive for a subsample in which the auditor-client relationship lasts for at least 9 years, the sample median of auditor tenure in our study. The results in Model 2 of panel A, Table 4, reveal that the coefficient on *TENURE* remains negative and significant at less than the 5 percent significance level. Also, the magnitude of the coefficient on *TENURE* is very similar to the coefficient for the subsample with auditor tenure of at least five years.

Subsample analysis: Agency conflicts

In this section, we seek to identify and understand the underlying economic factors that lead to cross-sectional differences in the economic consequences of auditor tenure to investors. The cross-sectional analyses make it difficult to argue for reverse causality. Our hypothesized relation between auditor tenure and future firm-specific crash risk is based conceptually on agency conflicts between managers and shareholders that ultimately lead to managerial bad news hoarding behavior. Kim et al. (2011a) and Callen and Fang (2013) suggest that firms with weaker monitoring mechanisms are prone to conceal bad news, and suffer crash risk. Thus, we expect that in firms with severe agency conflicts, external auditors play a greater monitoring role in preempting managerial bad news hoarding activity and reducing stock price crash risk. Empirically, we look at three aspects of agency conflict: (1) institutional monitoring, (2) auditor specialization, and (3) CEO characteristics.

First, we employ *TRA* to proxy for external weak monitoring. Bushee (1998, 2001) maintains that transient institutions effectively induce managerial opportunism, including bad news hoarding, due to their short-term orientation. Similarly, Gaspar et al. (2005) argue that inadequate monitoring due to the presence of short-term investors gives managers the opportunity to engage in activities for their private benefit while sacrificing the interests of shareholders. To support the argument, they provide evidence that firms with large *TRA* show poor market performance regarding mergers and acquisitions.

Second, past studies maintain that, relative to nonspecialist auditors, industry specialist auditors make greater investments in building their reputation and are more concerned about reputation risk and litigation exposure, ultimately bringing about a higher level of audit quality (Simunic and Stein 1987; Maletta and Wright 1996; Dunn and Mayhew 2004). Numerous empirical studies find that auditor specialization is positively associated with a variety of audit quality measures.[24] Following prior literature (Neal and Riley 2004; Lim and

[24] See Balsam et al. (2003), Dunn and Mayhew (2004), Knechel et al. (2007c), Lim and Tan (2008), Payne (2008), Behn et

Tan 2008; Reichelt and Wang 2010), we define an auditor to be an industry specialist (*SPEC*) when the auditor has the largest industry market share based on client sales. We also require at least 20 clients in a given industry for a particular year.

Third, we use CEO overconfidence (*CEO_OC*) to proxy for managerial characteristics related to agency problems within the firm. Kim et al. (2015) find that firms with overconfident CEOs are more likely to suffer stock price crashes, implying that overconfident CEOs tend to withhold privately observed negative feedback from outside shareholders. Following Malmendier and Tate (2005) and Campbell et al. (2011), we define a CEO as overconfident if the CEO exhibits option-holding behavior (i.e., holds stock options that are more than 100 percent in the money) at least twice during the sample period. We assign the variable *CEO_OC* a value of one, beginning with the first time the CEO exhibits overconfident behavior.

We split the sample into two subsamples based on the median value of *TRA*, the definitions of *SPEC* and *CEO_OC*, respectively. Then, we re-estimate equation (4) for each of the subsamples. Models 1 and 2 in panel B of Table 4 show that the coefficients on *TENURE* are significant and negative only for firms with the above-median value of *TRA*. Further, the coefficients on *TENURE* are much larger in absolute value for the subsample with the above-median value of *TRA* than for the subsample with the below-median value of *TRA*. Models 3 and 4 indicate that the coefficients on *TENURE* are negative and significant only for the non-*SPEC* group. Further, the coefficients on *TENURE* are much larger in absolute value for the non-*SPEC* group than for the *SPEC* group. Models 5 and 6 show that the coefficients on *TENURE* are significantly negative only for firms with high *CEO_OC*. Additional Chi-squared tests comparing the coefficients for *TENURE* across the subsamples shows that the differences between the coefficient estimates are significant across the subsamples of each of *TRA*, *SPEC* and *CEO_OC*.

Overall, the findings in panel B of Tables 4 are consistent with our conjecture that the term of the auditor-client relationship plays a more important role in reducing crash risk for firms with severe agency conflicts (a substitution effect). Our contextual findings substantiate the agency explanation in our main analyses; that is, the negative relation between auditor tenure and future crash risk is driven by managerial opportunistic bad news hoarding behavior.

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al. (2008) and Reichelt and Wang (2010). However, a recent study (Minutti-Meza 2013) casts doubt on these associations and suggests that self-selection might be a key driving force. DeFond and Zhang (2014) urge more research on the effect of self-selection in the specialization literature.

Two-stage least squares approach

Next, we estimate the relation between crash risk and auditor tenure using an instrumental variables two-stage least squares (2SLS) approach that controls for endogeneity-induced bias in the OLS estimates. In the first stage, we regress *TENURE* on the relevant instruments (described next) inclusive of industry and year fixed-effects controls. In the second stage, we re-estimate regression equation (4) using the predicted values of *TENURE* (*predTENURE*) from the first-stage regression. Instrumental variables that are correlated with the explanatory variable but uncorrelated with the error term are difficult to identify in most accounting research settings (Ittner and Larcker 2001; Chenhall and Moers 2007). A valid instrument should satisfy the following two conditions (e.g., Larcker and Rusticus 2010): (1) it is correlated with auditor tenure (the relevance condition); and (2) it is not directly related to crash risk other than through the hypothesized channel, auditor tenure (the exclusion restriction).

We use three instrumental variables for auditor tenure: an indicator of whether the firm has foreign operation(s) (*FOREIGN*); an indicator of whether a firm is in a technology industry (with SIC codes in 2830–2839, 3570–3579, 7370–7379, 8730–8739, and 3825–3839) (*HITECH*); and a continuous measure of assets intangibility (*INTAN*), measured by the ratio of intangible assets to total assets. Chaney et al. (2004) and Gul et al. (2009) suggest that firm complexity is likely to be associated with auditor retention, as the incumbent auditor usually has a better understanding of the client's business. Thus, firm complexity should meet the relevance condition. We utilize *FOREIGN* to proxy for firm complexity because firms with foreign operations are more likely to have more complex business activities. Further, to the extent that foreign operations are correlated with firm size and crash risk is related to firm size, we can try to ensure foreign operations have no direct correlation with the firm's crash risk other than through auditor tenure by controlling for firm size in the regression model (Larcker and Rusticus 2010; Dhaliwal et al. 2015).[25] The instrument, *INTAN*, is based on Chaney et al. (2004) and Ghosh and Tang (2015b) who find that audit risk is an important determinant of auditor turnover. DeFond and Zhang (2014) argue that, ceteris paribus, audit risk is expected to be higher for firms with difficult-to-measure innate characteristics, such as intangible assets. Thus, firms with a higher proportion of intangible assets are more likely to be associated with frequent auditor turnover because of greater audit risk, resulting in shorter auditor tenure. Last, Shu (2000) and Ghosh and Tang (2015b) maintain that industrial characteristics are also important factors affecting auditor tenure and argue that firms in the technology industries are more likely to experience frequent auditor turnover due to increased legal exposure to auditors. Similar to *FOREIGN*, we

[25] In the untabulated results, we further control for the number of business segments in the 2SLS model, since firms with foreign operations are likely to have diverse operations. Our results are not materially sensitive to this respecification.

also try to ensure that *INTAN* and *HITECH* satisfy the exclusion restriction by controlling for potential correlated variables in the model.

Model 1 of panel C, Table 4 presents the first-stage regression results in which auditor tenure is regressed on the instruments and the set of control variables from Table 2. The evidence show that *TENURE* is significantly positively associated with *FOREIGN* and negatively associated with *INTAN* and *HITECH*. The partial *F*-statistic is 45.7647 (*p*-value < 0.0001) indicating that the model is unlikely to be subject to a weak instruments problem. We also computed Stock and Yogo's (2005) test of weak instruments. The test statistic of 50.4862 far exceeds the critical values from Stock and Yogo (2005), again rejecting the null hypothesis of weak instruments.

To assess the endogeneity of the first-stage model statistically, we apply the Hausman (1978) test by regressing future crash risk on *TENURE* and on the residuals from the first-stage regression. If *TENURE* is truly exogenous to the set of instruments, the coefficient on the residuals should be insignificant. The results (untabulated) reject the exogeneity of *TENURE* at the 10 percent level, suggesting that endogeneity may be at issue.

Model 2 of panel C, Table 4 presents the second stage regression results. Consistent with our earlier findings, the coefficient on *predTENURE* is significantly negative at less than a 1 percent level (*t*-statistic=−3.24), suggesting that our main findings hold after controlling for endogeneity based on the instrumental variables approach. However, our instrumental variables approach is subject to some important caveats. In practice, it is often difficult to find convincing instruments to satisfy the exclusion restriction. In fact, the exclusion restriction cannot be tested directly (Wooldridge 2006). With more than one instrument, overidentification tests are possible under the assumption that one of the instruments is valid. Our overidentification test does not reject the null that the instruments are valid (*p*-value = 0.6987). Thus, our evidence from the instrumental variables approach should be interpreted with caution. Because of this caveat, we do not rely solely on the 2SLS analysis to help dispel endogeneity as a competing explanation for our core results.

Difference-in-differences approach

Lastly, we investigate the association between auditor tenure and stock price crash risk for audit clients that changed to other Big 4 auditors under the exogenous shock induced by the demise of AA in 2002. To establish a causal link, we need an exogenous shock that affects auditor tenure but has no direct effect on stock price crash risk. The forced auditor switches for former AA clients in 2002 provide a relatively clean randomized setting to test our hypothesis.

Specifically, we examine the effect of auditor tenure on crash risk focusing on the four-year periods before and after the demise of AA (i.e., 1998–2001 and 2003–2006). The selection of a four-year pre-post window reflects a balance between relevance and accuracy. On one hand, an excessively wide window potentially includes noise irrelevant to the event, and hence compromises the power of the test. On the other hand, there may be a lag between the disruption of the auditor-client relationship and the change to firms' crash risk. If so, using an overly narrow window might constrain our ability to detect significant changes in crash risk. Based on the above considerations, we select a four-year pre-post window based on the five-year cutoff of short versus long tenure in the extant literature (e.g., Myers et al. 2003; Ghosh and Moon 2005; Caramanis and Lennox 2008; Lennox and Pittman 2010). As a consequence, treatment firms (i.e., former AA clients) are in a short-term relationship with their successor Big 4 auditor for the four-year post-event period. We also require the treatment sample of former AA clients to have at least a five-year relationship with AA in the period before the demise of AA so that the forced switch for former AA clients reflects the disruption of a long-term auditor-client relationship. The untabulated results show that the mean and median of auditor tenure for the treatment sample in the four-year period prior to the event are 16.71 and 15 years, respectively.

For each firm in the treatment sample, we identify a control group of U.S. firms in the same industry (i.e., two-digit SIC code) that were audited by non-AA Big 4 auditors in year 2001 and did not experience an auditor switch in 2002. This control group of firms is initially matched to the treatment group based on industry and auditor tenure as measured one year prior to the event (i.e., year 2001). Of the latter group, we choose as a control the firm whose total assets are closest to those of the treatment firm. After imposing the requirement of data availability, the final sample consists of 126 pairs of treatment-control matches.

Panel D of Table 4 compares crash risk measure and other important firm characteristics between the treatment and the control groups in the pre-event year 2001. The comparison shows no statistically significant difference in *NCSKEW* between the treatment and control groups before the event. Also, differences in the matching variables (i.e., *TENURE* and *LNSIZE*) and almost all other firm characteristics between the treatment and the control groups are insignificant as well, although the treatment group looks slightly more leveraged than the control group. On the whole, the comparisons suggest that the matching procedure has successfully eliminated any meaningful distinctions between the treatment and control firms prior to the event, thereby helping to make sure that the change in *NCSKEW* is driven solely by the exogenous shock to auditor tenure. Nonetheless, we control for these firm characteristics in our difference-in-differences regression.

The difference-in-differences regression for the matched sample takes the form:

$$CRASHRISK_{jT} = \alpha_0 + \alpha_1 TREAT_{jT} + \alpha_2 POST_{jT} + \alpha_3 TREAT_{jT} \times POST_{jT} + \sum_k \alpha_k Controls_{jT}^k + \gamma_T + \delta_i + \varepsilon_{jT}, \quad (5)$$

where *TREAT* is an indicator variable that equals one for treatment firm observations, and zero otherwise; *POST* is an indicator variable that equals one if the observation is within the four-year period after the demise of AA (i.e., year 2002), and zero otherwise. The control variables are the same as in Table 2. The variable of interest is the interaction term *TREAT×POST*, which captures the incremental difference in stock price crash risk between treatment firms and control firms after the demise of AA. We expect α_3 to be positive given the forced disruption of the treatment firms' long-term relationship with AA and engagement with a new Big 4 auditor.

We report the results in panel E of Table 4. As shown in Model 1, the coefficient on the interaction term *TREAT×POST* is positive and statistically significant suggesting that relative to the control group, former AA clients experienced a higher level of stock price crash risk in the four-year period after the forced disruption of their long-term auditor relationship with AA and engagement with a successive Big 4 auditor. In Model 2, we further control for auditor industry specialization in case the auditor switch also resulted in a change in auditor expertise. The coefficient on the interaction term *TREAT×POST* remains significantly positive. In Model 3, we add auditor fixed effects as additional controls for unobservable heterogeneity of successive Big 4 auditors. Again, the coefficient on *TREAT×POST* remains significantly positive. Our results are also robust to alternative crash risk measures, *DUVOL* and *COUNT*, with the untabulated *t*-statistics ranging between 1.91 and 2.60. These findings are consistent with the monitoring-by-learning perspective, and support a causal interpretation of the cross-sectional analysis in the main test.[26]

It is difficult to completely dispel the possibility of endogeneity in our (or any) empirical design. Nevertheless, our robustness checks suggest a causal relation between auditor tenure and future stock price crash risk. In particular, we continue to find supportive evidence for our core results when we address potential endogeneity concerns with several identification techniques. Overall, the findings in this section are consistent with the notion that increased auditor tenure attenuates bad news hoarding activities which, as a result, reduces future stock price crash risk.

[26] Nevertheless, focusing on a small group of former AA clients makes the results vulnerable to the criticism of nongeneralizability. Hence, we suggest that readers exercise caution in interpreting these results.

Option smirk curve (i.e., ex ante crash risk) and future crash risk

Given our evidence that the term of the auditor-client relationship affects the stock price crash risk of client firms, a natural question to analyze is whether investors incorporate this information in their investment decisions. The recent empirical derivative literature suggests that the option-implied volatility smirk, measured as the difference between the implied volatility of out-of-the-money (OTM) puts and at-the-money (ATM) calls, reflects ex ante assessment by investors of the incidence and magnitude of future crashes (Bates 1991; Pan 2002; Kim and Zhang 2014). Specifically, a steep smirk curve implies that for the same underlying fundamentals, the implied volatility of OTM puts—which become extremely valuable in the event of a price crash—is high relative to that of ATM calls, consistent with investors trying to protect themselves against crashes. Bradshaw et al. (2010) and Kim and Zhang (2014) find that accrual manipulation and ex ante crash risk are positively correlated, consistent with the notion that capital markets (at least partially) impound the information conveyed by financial opacity about future crash risk in security prices.

Here we conjecture that if investors view auditors with longer-tenure clients as better equipped to preempt bad news hoarding activities, they will be less likely to purchase insurance for firms audited by such auditors in the form of OTM put options. This will result in less expensive OTM put options relative to ATM call options, so that we will observe less steepness in option-implied volatility smirks. Thus, we should expect a negative relation between auditor tenure and ex ante crash risk.

To test this conjecture, we estimate the regression:

$$Ex\ Ante\ CrashRisk_{jT} = \beta_0 + \beta_1 TENURE_{jT} + \sum_k \beta_k Controls_{jT}^k + \gamma_T + \delta_i + \varepsilon_{jT}. \quad (6)$$

Following prior research (Bollen and Whaley 2004; Xing et al. 2010; Yan 2011; Kim and Zhang 2014), we measure *Ex Ante CrashRisk* by the option-implied volatility smirk (*IV_SMIRK*), defined as the difference between the implied volatilities of OTM put options with a delta value between −0.375 and −0.125 and of ATM call options with a delta value between 0.375 and 0.625. To smooth out short-term movements in the smirk curve, we calculate an annual measure of the option-implied volatility smirk by averaging the daily implied volatility smirk for each year. When there are multiple OTM and ATM options for the stock on a particular day, we further calculate average implied volatility for all available options on that day, weighted by option open interest. It is important to note that *IV_SMIRK* captures investors' perceptions or fear of future crashes, not realized crashes (Kim and Zhang 2014).

Following the literature (e.g., Dennis and Mayhew 2002; Van Buskirk 2011; Kim and Zhang 2012), we also control for the following variables: the average daily implied volatility of ATM call options over the fiscal year (*ATM_IV*); the market beta of the firm estimated using daily stock and market returns over the fiscal year (*BETA*); the standard deviation and the negative skewness of the daily stock return over the fiscal year, respectively (*STOCK_VOLA* and *RET_NCSKEW*); the cumulative raw daily stock return over the fiscal year (*STOCK_RET*); the standard deviation of operating cash flows, earnings before extraordinary items, and sales revenue (scaled by lagged total assets) over the past five years, respectively (*CFO_VOLA*, *EARNINGS_VOLA*, and *SALES_VOLA*); *LNSIZE*, *LEV*, *MB*, *ACCRM*, *DTURNOVER*, *SIGMA*, and *TENURE* as defined above in the discussion of equation (4).

Table 5, panel A shows the regression results for equation (6). The coefficient on *TENURE* is negative at less than a 5 percent significance level. The decrease in *IV_SMIRK* corresponding to a shift from the 25th to the 75th percentile of *TENURE* is 2.62 percent of the sample mean. The results are consistent with investors incorporating the information about price crash risk conveyed by the term of the auditor-client relationship into their investment decisions.

A related question is whether the option-implied smirk curve *fully* captures the information regarding bad news hoarding behavior embedded in the auditor-client relationship. To the extent that investors are sufficiently prescient, we should expect no relation between auditor tenure and future crash price risk after controlling for ex ante crash risk. In contrast, if auditor tenure can still forecast future crash risk even after controlling for option-implied volatility smirk, then it appears that investors do not fully understand, or at least underestimate, the information stemming from the term of the auditor-client relationship affecting future crash propensity. To investigate this possibility, we include *IV_SMIRK* in equation (4) and re-estimate the equation.

Table 5, panel B provides the regression results of equation (4) after including both regressors, *IV_SMIRK* and *TENURE*. Consistent with Kim and Zhang (2014), we find that *IV_SMIRK* is significant in predicting two of the three future crash risk measures, one-year-ahead *NCSKEW* and *DUVOL*, implying that the option price at least partially reflects information about future stock price crash risk. More importantly, the coefficient on *TENURE* remains significantly negative at less than the 10 percent level across all three crash risk measures. This evidence suggests that investors do not *fully* recognize the information embedded in the auditor-client relationship as a predictor of bad news hoarding behavior and crash risk. Thus, the term of the audit-client relationship can be used to predict future crash risk beyond the information conveyed by the option-implied volatility smirk.

Corroboration of bad news hoarding in stock price crashes

The premise underlying the prior empirical literature that idiosyncratic crashes are caused by bad news hoarding is difficult, if not impossible, to test based on public information. In order to help confirm that the subsequent stock price crashes in our study are a consequence of bad news hoarding, we follow the approach of Callen and Fang (2015) and investigate firms that adversely restated financial reports. Specifically, we identify a group of firms with income-decreasing restatements from the Audit Analytics database. In general, these firms were involved in various accounting irregularities, such as concealing weak revenues or excessive expenses (or both). These irregularities are brought to light at least one year and often many years after they occur. Thus, we are fairly confident that these firms withheld negative information from shareholders. We further restrict the restatement firms to those with the required data on COMPUSTAT and CRSP, resulting in 3,666 distinct income-decreasing restatements for the period 2000 to 2011.

Next, for each of the restatements, we estimate firm-specific daily returns over the three days before and after the restatement announcement. Based on Hutton et al. (2009), a stock price is presumed to suffer a crash if the firm-specific daily return on any day during the announcement window is 3.09 standard deviations below the annual mean. We obtain 376 restatements with price crashes over the announcement window. We match each of the 376 firms with a restatement firm in the same industry that did not suffer a crash. The control firm chosen is the one that has total assets closest to that of the treatment firm. Table 6 indicates that the mean firm-specific daily return for the treatment group is −19.42 percent, which by construction is significantly larger in magnitude than the control group (*t*-statistic = 17.54).

Table 6 shows that the differences in mean and median values of *TENURE* between the treatment and control groups are 28.87 percent (= (9.64−7.48)/7.48) and 33.33 percent (= (8−6)/6), respectively. Importantly, the treatment group exhibits significantly shorter auditor tenure than the control group (*t*-statistic = 2.13 (2.24), *p*-value = 0.033 (0.025)), for the difference in means (medians). This evidence is in line with the idea that price crashes arising out of bad news hoarding are associated with shorter auditor-client relationships.

5. Conclusion

In this study, we investigate whether the term of the auditor-client relationship is associated with future stock price crash risk. Using a large sample of U.S. public firms with Big 4 auditors from the years 1981 to 2011, we find robust evidence that auditor tenure is negatively related to one-year-ahead stock price crash risk. Our empirical results are consistent with the monitoring-by-learning perspective that developing client-specific knowledge over the term of the auditor-client relationship enables auditors to detect and deter bad news hoarding activities by audit clients, thus reducing future stock price crash risk. Also, using data from the option market, we document that option market investors do not *fully* recognize the information contained in the term of audit-client relationship in predicting future stock price crash risk.

From a methodological perspective, by focusing on stock price crash risk, a comprehensive market-based outcome measure, our study provides more robust findings regarding the relation between auditor tenure and managerial manipulation of bad news in comparison to prior literature that centers on a specific manipulation channel such as accruals or classification shifting. Research that centers on one specific channel could easily lead to false inferences about this relation. Our paper in this regard responds to the call from the PCAOB for evidence on the role that auditors played in corporate financial disclosures during the recent financial crisis (PCAOB 2011c, 2012).

Appendix

Variable definitions

Crash risk measures	
NCSKEW	Negative coefficient of skewness of firm-specific daily returns over the fiscal year. We estimate firm-specific daily returns as the natural log of one plus the residual return from equation (1) in the text
DUVOL	Log of the ratio of the standard deviation of firm-specific daily returns for the "down" subsample to standard deviation of firm-specific daily returns for the "up" subsample over the fiscal year
COUNT	Number of firm-specific daily returns exceeding 3.09 standard deviations below the mean firm-specific daily return over the fiscal year, minus the number of firm-specific daily returns exceeding 3.09 standard deviations above the mean firm-specific daily return over the fiscal year, with 3.09 selected as a cutoff to yield frequencies of 0.1 percent in the normal distribution
Auditor tenure measure	
TENURE	Number of consecutive fiscal years that the auditor has been retained by the client, up to and including the current year (in the case of audit firm mergers, the incumbent auditor-client relationship is considered to be the continuation of the prior auditor). COMPUSTAT provides the available data to calculate auditor tenure
Other variables	
KUR	Kurtosis of firm-specific daily returns over the fiscal year
SIGMA	Standard deviation of firm-specific daily returns over the fiscal year
RET	Cumulative firm-specific daily returns over the fiscal year, multiplied by 100
MB	Ratio of the market value of equity to the book value of equity at the end of the fiscal year
LEV	Book value of all liabilities divided by total assets at the end of the fiscal year

ROA	Operating earnings divided by total assets at the end of the fiscal year
LNSIZE	Log value of market capitalization at the end of the fiscal year
DTURN	Average monthly share turnover over the fiscal year minus the average monthly share turnover over the previous year, where monthly share turnover is calculated as the monthly share trading volume divided by the number of shares outstanding over the month
AGE	Number of years that the firm has been listed on COMPUSTAT since 1950
ACCRM	Three-year moving sum of the absolute value of annual performance-adjusted discretionary accruals developed by Kothari et al. (2005)
TRA	Percentage of a specific firm's equity held by transient institutional investors at the end of the fiscal year
ANA	Log value of one plus the number of analysts that issue earnings forecasts for a given firm during the fiscal year
C_SCORE	Firm-year conservatism measure from Khan and Watts (2009)
SPEC	Equal to one when an auditor has the largest industry market share in the fiscal year, and zero otherwise
CEO_OC	Equal to one if CEO exhibits option-holding behavior (i.e., holding stock options that are more than 100 percent in the money) at least twice during the sample period, and zero otherwise
FOREIGN	Equal to one if a firm has foreign operation(s), and zero otherwise
HITECH	Indicator of whether a firm is in a technology industry (with SIC codes in 2830–2839, 3570–3579, 7370–7379, 8730–8739, and 3825–3839)
INTAN	Ratio of intangible assets to total assets at the end of the fiscal year
TREAT	Indicator variable that equals one for treatment firm observations, and zero otherwise
POST	Indicator variable that equals one if the observation is within the four-year period after the demise of Arthur Andersen (i.e., year 2002), and zero otherwise
IV_SMIRK	Difference between the implied volatilities of out-of-the-money (OTM) puts and at-the-money (ATM) calls
ATM_IV	Average daily implied volatility level of ATM call options over the fiscal year
BETA	Market beta for the firm, which is estimated using daily stock and market returns over the fiscal year
STOCK_VOLA	Standard deviation of daily stock returns over the fiscal year
RET_NCSKEW_T	Negative skewness of daily stock returns over the fiscal year
STOCK_RET	Accumulated raw daily stock return over the fiscal year
CFO_VOLA	Standard deviation of operating cash flows (scaled by lagged total assets) over the past five years
EARNINGS_VOLA	Standard deviation of earnings before extraordinary items (scaled by lagged total assets) over the past five years
SALES_VOLA	Standard deviation of sales revenue (scaled by lagged total assets) over the past five years

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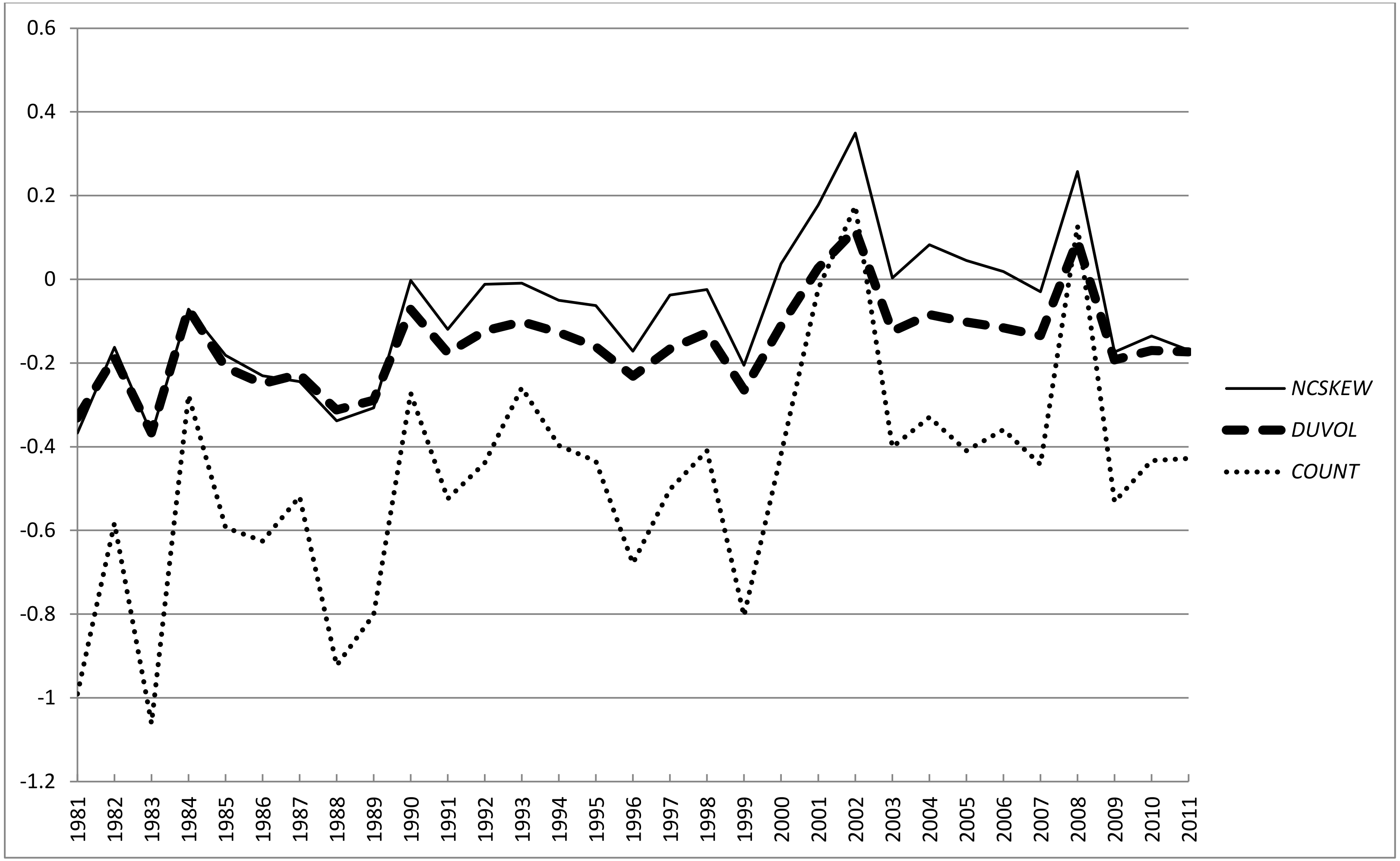
Figure 1 Means of crash risk measures across the sample years 1981-2011



Notes:

This figure plots the means of the multiple crash risk measures, *NCSKEW*, *DUVOL*, and *COUNT*, across the sample years 1981 to 2011.

TABLE 1
Summary statistics

Panel A: Descriptive statistics

Variables	*N*	Mean	Std. dev.	p5	p25	Median	p75	p95
$NCSKEW_{T+1}$	56,667	-0.1407	1.4990	-1.9775	-0.5831	-0.1658	0.2456	2.0364
$DUVOL_{T+1}$	56,666	-0.1699	0.6456	-1.1365	-0.4951	-0.1695	0.1592	0.8561
$COUNT_{T+1}$	56,667	-0.4240	1.6605	-3.0000	-2.0000	0.0000	1.0000	2.0000
$TENURE_T$	56,667	10.5807	7.3271	2.0000	5.0000	9.0000	14.0000	27.0000
$NCSKEW_T$	56,667	-0.0410	1.2568	-1.4677	-0.5353	-0.1552	0.2400	1.9838
KUR_T	56,667	5.9644	9.2618	0.4220	1.4276	2.8040	6.0616	23.4345
$SIGMA_T$	56,667	0.0280	0.0151	0.0110	0.0172	0.0243	0.0351	0.0576
RET_T	56,667	-0.0505	0.0626	-0.1652	-0.0613	-0.0295	-0.0148	-0.0060
MB_T	56,667	3.0239	3.4495	0.6959	1.3161	2.0340	3.3644	8.4090
LEV_T	56,667	0.4841	0.2056	0.1369	0.3286	0.4976	0.6362	0.8096
$LNSIZE_T$	56,667	20.0358	1.8261	17.2445	18.6900	19.9264	21.2515	23.3991
ROA_T	56,667	0.1121	0.1511	-0.1366	0.0797	0.1298	0.1833	0.2857
$DTURN_T$	56,667	0.0032	0.0832	-0.1210	-0.0209	0.0014	0.0262	0.1358
AGE_T	56,667	14.2482	8.2885	4.0000	8.0000	12.0000	19.0000	31.0000
$ACCRM_T$	56,667	0.1886	0.1623	0.0380	0.0855	0.1420	0.2350	0.5068
ANA_T	56,667	1.8461	0.7866	0.6931	1.0986	1.7918	2.4849	3.1781
TRA_T	56,667	0.1211	0.1080	0.0021	0.0340	0.0923	0.1807	0.3421

Panel B: Correlation matrix

	$NCSKEW_{T+1}$	$DUVOL_{T+1}$	$COUNT_{T+1}$	$TENURE_T$	$NCSKEW_T$	KUR_T	$SIGMA_T$	RET_T	MB_T	LEV_T	$LNSIZE_T$	ROA_T	$DTURN_T$	AGE_T	$ACCRM_T$	ANA_T
$DUVOL_{T+1}$	0.92															
	0.00															
$COUNT_{T+1}$	0.46	0.64														
	0.00	0.00														
$TENURE_T$	0.00	0.01	0.02													
	0.41	0.03	0.00													
$NCSKEW_T$	0.03	0.04	0.02	-0.01												
	0.00	0.00	0.00	0.02												
KUR_T	0.01	-0.01	-0.01	0.00	0.37											
	0.21	0.00	0.01	0.77	0.00											
$SIGMA_T$	0.00	-0.03	-0.05	-0.25	0.09	0.18										
	0.48	0.00	0.00	0.00	0.00	0.00										
RET_T	0.01	0.04	0.05	0.21	-0.05	-0.17	-0.95									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
MB_T	0.07	0.06	0.05	-0.01	-0.04	0.01	0.06	-0.06								
	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00								
LEV_T	-0.03	-0.02	0.00	0.11	-0.02	-0.01	-0.16	0.12	0.11							
	0.00	0.00	0.53	0.00	0.00	0.03	0.00	0.00	0.00							
$LNSIZE_T$	0.08	0.11	0.13	0.28	0.02	0.01	-0.51	0.42	0.22	0.14						
	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00						
ROA_T	0.04	0.07	0.09	0.13	0.00	-0.08	-0.42	0.42	-0.04	0.06	0.27					
	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00					
$DTURN_T$	0.04	0.04	0.04	0.02	0.05	0.10	0.08	-0.08	0.09	0.03	0.07	0.06				
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
AGE_T	0.01	0.03	0.04	0.65	0.00	0.03	-0.31	0.26	-0.03	0.18	0.37	0.14	0.03			
	0.14	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
$ACCRM_T$	0.02	0.01	-0.01	-0.20	0.01	0.01	0.34	-0.29	0.14	-0.10	-0.24	-0.12	0.01	-0.26		
	0.00	0.03	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
ANA_T	0.07	0.09	0.10	0.16	0.08	0.00	-0.37	0.32	0.11	0.07	0.66	0.23	0.04	0.13	-0.15	
	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TRA_T	0.10	0.10	0.10	0.03	0.02	0.09	-0.02	0.06	0.15	-0.06	0.24	0.05	0.13	0.09	0.00	0.29
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00

Notes:

The sample covers 56,667 firm-year observations with nonmissing values for all control variables for the period 1981 to 2011. Panel A presents descriptive statistics of key variables of interest for the sample of firms. Panel B presents Pearson correlations between key variables of interest for the sample. The two-tailed *p*-values are below the correlation coefficients. All variables are defined in the Appendix.

TABLE 2
Impact of auditor tenure on crash risk

Dependent variable	Alternative measures of crash risk					
	NCSKEW $_{T+1}$		***DUVOL*** $_{T+1}$		***COUNT*** $_{T+1}$	
	Model 1		**Model 2**		**Model 3**	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Test variables						
$TENURE_T$	-0.0030**	(-2.43)	-0.0014***	(-2.66)	-0.0042***	(-3.13)
Control variables						
$NCSKEW_T$	0.0254***	(3.43)	0.0194***	(6.31)	0.0242***	(4.05)
KUR_T	-0.0027***	(-2.76)	-0.0027***	(-6.64)	-0.0044***	(-5.46)
$SIGMA_T$	14.4543***	(8.66)	4.5640***	(6.02)	5.6609***	(2.75)
RET_T	2.9437***	(9.04)	0.9989***	(6.50)	1.4863***	(3.39)
MB_T	0.0166***	(7.59)	0.0073***	(7.97)	0.0138***	(5.83)
LEV_T	-0.2051***	(-5.79)	-0.0880***	(-5.70)	-0.1539***	(-3.80)
$LNSIZE_T$	0.0685***	(11.05)	0.0298***	(10.64)	0.0712***	(9.44)
ROA_T	0.2612***	(4.59)	0.2337***	(10.01)	0.7004***	(12.43)
$DTURN_T$	0.3453***	(4.34)	0.1728***	(5.13)	0.4899***	(5.55)
AGE_T	0.0003	(0.21)	0.0004	(0.70)	0.0006	(0.44)
$ACCRM_T$	0.2223***	(4.94)	0.0990***	(5.01)	0.1303***	(2.62)
ANA_T	0.0328***	(2.81)	0.0139***	(2.65)	0.0404***	(2.95)
TRA_T	0.8821***	(11.51)	0.3714***	(11.80)	0.9394***	(12.04)
Intercept	-1.9874***	(-13.99)	-0.9318***	(-14.91)	-2.1719***	(-13.25)
Year fixed effects	Included		Included		Included	
Industry fixed effects	Included		Included		Included	
N	56,667		56,666		56,667	
Adj. R^2	0.0353		0.0582		0.0503	

Notes:

This table presents estimation results from the pooled cross-sectional regression of future stock price crash risk on auditor tenure. The sample covers firm-year observations with non-missing values for all variables for the period 1981 to 2011. The *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. All variables are defined in the Appendix.

*, **, and *** indicate statistical significance in two-tailed tests at the 10 percent, 5 percent, and 1 percent levels, respectively.

TABLE 3
Sensitivity tests

Dependent variable:			*NCSKEW*$_{T+1}$		
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Test variable	Natural log	Indicator variable	Fama-MacBeth	Control for DD accrual	Control for *C*
$TENURE_T$	-0.0298***	-0.0452***	-0.0033**	-0.0035***	-0.0031**
	(-3.20)	(-3.04)	(-2.59)	(-2.83)	(-2.56)
Controls	Included	Included	Included	Included	Included
N	56,667	56,667	56,667	56,667	56,667
Adj. R^2	0.0373	0.0373	0.0264	0.0347	0.0363

Notes:

This table presents estimation results from the pooled cross-sectional regression of future stock price crash risk on auditor tenure. Models 1 and 2 present the regression results with auditor tenure measured by the log value of and dummy variable of $TENURE_T$, respectively. Model 3 provides the regression results using the Fama and MacBeth (1973) approach. Model 4 controls for the Dechow-Dichev (2002) (DD) accrual quality measure as modified by Francis et al. (2005). Model 5 provides the estimation results after controlling for the Khan-Watts (2009) *C_Score*. Model 6 shows the regression results after controlling for firm fixed effects. To economize on space, all control variables (see Table 2) are suppressed. The *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. All variables are defined in the Appendix.

*, **, and *** indicate statistical significance in two-tailed tests at the 10 percent, 5 percent, and 1 percent levels, respectively.

TABLE 4
Endogeneity tests

Panel A: Long-tenure sample

Dependent variable:	*NCSKEW*$_{T+1}$	
	Model 1	**Model 2**
Test variable	Tenure >=5 years	Tenure >=9 years
$TENURE_T$	-0.0053***	-0.0055**
	(-3.13)	(-2.03)
Controls	Included	Included
N	44,889	28,793
Adj. R^2	0.036	0.0326

Panel B: Subsample analysis based on agency conflicts

Dependent variable:	$NCSKEW_{T+1}$					
	TRA		**AUDITOR**		***CEO_OC***	
	High	***Low***	***NON-SPEC***	***SPEC***	***High***	***Low***
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Test variables						
$TENURE_T$	-0.0057***	0.0005	-0.0051***	0.0018	-0.0086***	-0.0016
	(-3.35)	(0.30)	(-3.52)	(0.75)	(-2.93)	(-0.75)
Controls	Included	Included	Included	Included	Included	Included
No. of observations	28,333	28,334	40,791	14,900	6,501	11,221
Adj. R^2	0.0338	0.0272	0.0363	0.0311	0.025	0.0264
Difference in subsample coefficients:						
$TENURE_T$	Chi-squared =6.82;		Chi-squared =6.28;		Chi-squared =3.68;	
	p-value = 0.0090		p-value = 0.0122		p-value = 0.0552	

Panel C: Two-stage least squares

	First Stage (Dep. Var. = $TENURE_T$) Model 1		Second Stage (Dep. Var. = $NCSKEW_{T+1}$) Model 2	
	Coeff.	t-stat.	Coeff.	t-stat.
Instrumental variables				
$FOREIGN_T$	0.4089***	(2.98)		
$INTAN_T$	-1.4127***	(-3.26)		
$HITECH_T$	-0.5265**	(-2.15)		
Test variable				
$predTENURE_T$			-0.0823***	(-3.24)
Controls	Included		Included	
No. of observations	56,667		56,667	

Adj. R^2	0.4906		0.0374
Partial F-stat	45.7647	p value<0.0001	
Stock and Yogo (2005) test statistic	50.4862		
Critical values corresponding to a relative bias of no more than 5%:			
2SLS relative bias	13.91		
Critical values corresponding to a rejection rate of no more than 10%:			
2SLS Size of nominal 5% Wald test	22.30		
LIML Size of nominal 5% Wald test	6.46		
Over-identification test:			
Score Chi squared	0.7171	p value=0.6987	

Panel D: Descriptive statistics for the sample of the difference-in-differences approach in the pre-event year 2001

	Treatment group	Control group	*t*-stat. for difference in mean
Variable	Mean	Mean	
$NCSKEW_T$	0.0958	0.1154	-0.22
$TENURE_T$	18.1644	18.1644	0.00
KUR_T	1.6353	1.4008	0.77
$SIGMA_T$	0.0638	0.0648	-0.26
RET_T	-0.0242	-0.0254	0.44
MB_T	3.0084	2.9420	0.17
LEV_T	0.5342	0.4879	1.86*
$LNSIZE_T$	20.4172	20.4744	-0.27
ROA_T	0.1270	0.1072	1.28
$DTURN_T$	-0.0188	-0.0145	-0.37
AGE_T	19.5479	20.2534	-0.79
$ACCRM_T$	0.1743	0.1708	0.22
ANA_T	1.7777	1.8255	-0.52
TRA_T	0.1331	0.1353	-0.18

Panel E: Difference-in-differences regression

Dependent Variable:		$NCSKEW_T$	
	Model 1	**Model 2**	**Model 3**
Test variables			
$TREAT_T$	-0.0571	-0.0829*	-0.1198**
	(-1.25)	(-1.82)	(-2.20)
$POST_T$	-0.2239***	-0.2304***	-0.2321***
	(-2.78)	(-2.86)	(-2.84)
$TREAT_T \times POST_T$	0.1548**	0.1632**	0.2048**
	(2.20)	(2.31)	(2.50)
Controls	Included	Included	Included
N	1,978	1,976	1,976
Adj. R^2	0.1139	0.1157	0.1164

Notes:

This table reports the results of multiple identification tests to deal with the potential endogeneity of auditor tenure. Panel A presents the regression results using the subsamples in which the auditor-client relationship lasted for at least 5 years and 9 years, respectively. Panel B provides the regressions results for subsample analyses based on agency conflict: (1) transient institutional monitoring (*TRA*); (2) auditor specialization (*SPEC*); and (3) CEO overconfidence (*CEO_OC*). We estimate equation (4) for subsamples based on the median value of *TRA*, and the definitions of *SPEC* and *CEO_OC*, respectively. We conduct additional Chi squared tests comparing the coefficients for *TENURE* across the subsamples. Panel C employs an instrumental variable two-stage least squares approach. The instruments for the first stage are: *FOREIGN*, an indicator of whether the firm has foreign operation(s); *HITECH*, an indicator of whether a firm is in a technology industry (with SIC codes in 2830-2839, 3570-3579, 7370-7379, 8730-8739, and 3825-3839); and *INTAN*, the ratio of intangible assets to total assets. In the second stage, we re-estimate regression equation (4) using the predicted values of *TENURE* (*predTENURE*) from the first-stage regression. Panel D provides descriptive statistics in the pre-event year, 2001, for the difference-in-differences sample based on the shock to auditor tenure induced by the demise of Arthur Andersen in 2002. Treatment firms are long-tenured former Arthur Andersen clients. The control group are firms in the same industry, matched in 2001 with a client of non-AA auditor on auditor tenure and total asset size. In the last column of Panel D, we report *t*-statistics for the univariate comparisons of all variables between the treatment and the control groups. Panel E provides estimation results for the difference-in-differences analysis. The analysis focuses on crash risk within the 4-year periods before and after the demise of Arthur Andersen (i.e., 1998-2001 and 2003-2006). To economize on space, all control variables (see Table 2) are suppressed. The *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. All variables are defined in the Appendix. *, **, and *** indicate statistical significance in two-tailed tests at the 10 percent, 5 percent, and 1 percent levels, respectively.

TABLE 5
Auditor tenure and ex ante crash risk

Panel A: Auditor tenure and option-implied volatility smirk

Dependent Variable:	IV_SMIRK_T	
	Coeff.	*t*-stat.
Test variable		
$TENURE_T$	-0.0001**	(-2.57)
Control variables		
ATM_IV_T	0.0087	(1.12)
$LNSIZE_T$	-0.0003	(-1.02)
LEV_T	0.0070***	(3.76)
MB_T	0.0002**	(2.29)
$ACCRM_T$	0.0026*	(1.82)
$DTURN_T$	-0.0029	(-0.97)
$BETA_T$	0.0019	(1.61)
$SIGMA_T$	0.0871	(0.45)
$STOCK\_VOLA_T$	0.3055*	(1.80)
RET_NCSKEW_T	-0.0003	(-1.08)
$STOCK\_RET_T$	0.0011**	(1.99)
CFO_VOLA_T	0.0029	(1.21)
$EARNINGS\_VOLA_T$	0.0008	(0.29)
$SALES\_VOLA_T$	0.0008	(0.64)
AGE_T	-0.0001*	(-1.80)
Intercept	0.0419***	(5.45)
Year fixed effects	Included	
Industry fixed effects	Included	
N	18,339	
Adj. R^2	0.2389	

Panel B: Auditor tenure and future stock price crash risk, controlling for option-implied volatility smirk

Dependent Variable:	$NCSKEW_{T+1}$		$DUVOL_{T+1}$		$COUNT_{T+1}$	
	Model 1		**Model 2**		**Model 3**	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Test variables						
IV_SMIRK_T	0.9115**	(2.35)	0.3358**	(2.03)	0.0968	(1.24)
$TENURE_T$	-0.0032**	(-2.05)	-0.0014*	(-1.96)	-0.0034**	(-2.01)
Control variables						
$NCSKEW_T$	0.0078	(0.65)	0.0105**	(2.10)	0.0041	(0.45)
KUR_T	0.0005	(0.28)	-0.0010	(-1.43)	-0.0005	(-0.42)
$SIGMA_T$	15.2256***	(3.78)	3.9721**	(2.32)	2.8952	(0.66)
RET_T	3.4930***	(3.88)	1.2245***	(3.14)	1.4802	(1.45)
MB_T	0.0121***	(3.16)	0.0058***	(3.92)	0.0171***	(4.52)
LEV_T	-0.3108***	(-4.32)	-0.1407***	(-4.88)	-0.2964***	(-4.30)
$LNSIZE_T$	0.0782***	(6.27)	0.0362***	(6.82)	0.0807***	(5.89)
ROA_T	-0.0410	(-0.33)	0.1184**	(2.51)	0.4425***	(4.25)
$DTURN_T$	0.2939**	(2.33)	0.1587***	(3.06)	0.4544***	(3.43)
AGE_T	0.0019	(1.05)	0.0009	(1.14)	0.0020	(1.03)
$ACCRM_T$	0.2233*	(1.94)	0.1002**	(2.16)	0.2147**	(2.03)
ANA_T	0.0317	(1.43)	0.0162*	(1.75)	0.0195	(0.83)
TRA_T	0.8465***	(6.25)	0.4039***	(7.52)	1.0302***	(8.24)
Intercept	-2.1715***	(-7.68)	-1.0566***	(-8.85)	-2.2894***	(-7.55)
Year fixed effects	Included		Included		Included	
Industry fixed effects	Included		Included		Included	
N	18,339		18,339		18,339	
Adj. R^2	0.0253		0.0514		0.0505	

Notes:

This table provides estimation results of the relation between auditor tenure, option-implied volatility smirk (ex ante crash risk), and future stock price crash risk. Panel A presents estimation results from the pooled cross-sectional regression of option-implied volatility smirk on auditor tenure. Panel B presents estimation results from the pooled cross-sectional regression of future stock price crash risk on auditor tenure controlling for option-implied volatility smirk. The sample covers 18,339 firm-year observations with nonmissing values for all variables for the period 1996 to 2011. The *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. All variables are defined in the Appendix. *, **, and *** indicate statistical significance in two-tailed tests at the 10 percent, 5 percent, and 1 percent levels, respectively.

TABLE 6
Bad news hoarding, restatements and crash risk

	# of observations	Mean firm-specific daily returns	Mean *TENURE*	Median *TENURE*
Treatment group:				
Restatements with crash	376	-19.42%	7.48	6
Matched Control group (matched by industry and size):				
Restatements without crash	376	-3.81%	9.64	8
t-statistic for difference between groups		17.54***	2.13**	2.24**

Notes:

This table compares mean firm-specific daily returns measured three days before and after the restatement announcement, and auditor tenure (mean and median) for a sample of restatement firms with crashes and a matched (by industry and size) control sample of restatement firms without crashes. *, **, and *** indicate statistical significance in two-tailed tests at the 10 percent, 5 percent, and 1 percent levels, respectively.